PUBLICATIONS OF THE UNIVERSITY OF MANCHESTER

MEDICAL SERIES

No. XII.

Modern Problems

IN

Psychiatry

Sherratt & Hughes
Publishers to the Victoria University of Manchester
London: 33 Soho Square, W.
Manchester: 34 Cross Street

Agents for the United States
Longmans, Green & Co.
443-449 Fourth Avenue, New York

Modern Problems
IN
Psychiatry

BY
ERNESTO LUGARO
Professor Extraordinary of Neuropathology and Psychiatry
in the University of Modena

TRANSLATED BY
DAVID ORR, M.D.
AND
R. G. ROWS, M.D.

WITH A FOREWORD BY
SIR T. S. CLOUSTON, M.D., LL.D.

MANCHESTER
AT THE UNIVERSITY PRESS
1913

University of Manchester Publications
No. XLVII.

First Edition, 1909 Second Edition, 1913

CONTENTS

Foreword

By T. S. Clouston, M.D., LL.D.

When Dr. David Orr and Dr. R. G. Rows asked me to write a "Foreword" to their translation of Lugaro's work, the first motive for acceding to their request which occurred to me was the heavy obligation under which all workers in science are placed to those who undertake the thankless drudgery of translating a good foreign scientific book into the English language. Few British readers are so familiar with Italian that they do not enjoy and understand a book in English better than if untranslated. If the work is one of high importance, closely reasoned, full of technical language and new views of the subject treated, then a good translation is a real addition to our scientific armamentarium and may be a great stimulus to scientific work. I can well remember the effect on British Medicine which Dr. Chance's translation of Virchow's "Cellular Pathology" made in 1860. The work of Lugaro in Psychiatry has been known in a general way for years to British workers in that department, but the width, subtlety, and grasp of his mind, and what he has done to bring Psychiatry out of its former isolation in Science, was known to few in this country.

I had not read much of the translation before I found that Lugaro was one of the master spirits of biological science, who, while knowing and using the details and facts of his subject, was not content with a narrow and

technical view of it, but pressed into its elucidation all the correlated sciences of anatomy, physiology, biology, and psychology. Some other men have before attempted to do this, but while mustering many of the facts of those sciences failed to show their exact bearing on the subject of the mental disturbances and defects of the human brain. Lugaro seems to me to have been able to set the whole problem of Psychiatry before his mind, to have realised its extraordinary difficulties, and to have pointed out future lines of research more clearly and fully than almost any of our modern authors. He combines caution with scientific enthusiasm. He avoids immature inductions. He knows just how far his facts will take him. He is not carried away by impracticable theory as so many authors of the Latin races have been. He is reliable and practical, while retaining the subtle mental qualities of his race. He does not offend the common sense of the average man nor the conservatism of the lawyer in his conclusions and advice as to how criminals and cranks should be treated by society. He gives the impression that he would be a safe guide in the witness box, at the bedside, or to the social reformer. Those qualities will certainly commend him to British readers.

One cannot read the book without receiving an overpowering impression of the author's love of truth and of his intense craving to get nearer to solid ground in the abstruse questions with which Psychiatry abounds. He traces its history up to the present time, he points out its difficulties, he argues for specialism, but it must be a wide reaching specialism. He realises that the organ whose functions and diseases he is discussing is the acme and the object of the evolutionary process in Nature, and has in it qualities, risks, and defects which are related to every biological, physiological, and pathological fact and law in Nature. In his psychological chapter he faces up the differences and the parallelisms of objective phenomena, physical law, and states of

consciousness. " In no way can we from the point of view of determinism, compare the succession of states of consciousness with the sequence of objective phenomena," but, he adds, the " states of consciousness are accompanied by objective processes which take place in the nerve centres without which they could not exist." In this department of his subject he soon runs against the dead wall of the unthinkableness of any causal relationship between mind and organisation.

In his anatomical chapter he is specially attracted by the importance of Flechsig's association work. He considers it throws much light on mental development in the child and on other autogenetic and phylogenetic problems. His exposition of the neurone doctrine and its mental relations is clear, concise, and dogmatic. The " law of dynamic polarization " is brought in effectively for his purpose. The psychological deductions from the anatomical facts are of great practical interest to the psychiatrist. He impressively correlates many psychical conditions with the objective facts of embryological development, homologating Ramon y Cajal's theory of "chemotropism," which in his opinion explains the " orientation " of the developing nerve fibres, whereby they push their way from the mother neurone to the periphery of the body to innervate the various tissues and organs. He finds in the cortex an anatomical basis for the new associations of ideas and the consolidation of memories in the child and young adult. Afterwards he finds in the atrophy of those association fibres an explanation of many mental facts which occur in dementia, catatonia, and other insanities. He brings in Cajal's " Law of Avalanche " also to explain many hitherto obscure psychological phenomena and psychiatric symptoms. Similarly he brings in the Nissl substance and the neuroglia for like explanations. We practical Britons naturally ask how all this bears on

mental disease? He tries to answer this question so far as the facts will enable him to do so.

The whole chapter is necessarily full of theory, but it is a real attempt by an acute and honest mind which knows the most recent anatomical facts, to throw light on the clinical facts of psychiatry. He tries to counteract our common looseness and vagueness of thought in regard to those facts. It is highly suggestive too, its perusal making the instructed reader ask many questions. No student of the subject should omit to read what Lugaro says on those matters, for it seems to me to bring mental facts and brain organisation closer together and makes them more comprehensible than any existing book on Psychiatry.

In his chapter on Pathogenesis he treats lucidly of the pathogenetic importance of abnormal stimuli from organs other than the brain in causing psychoses. His exposition as to how stimuli, coarse and fine, direct and indirect, may be diffused, selected, inhibited, and transformed in and by the neurones in the cerebral cortex, has much practical importance. He dwells on the selective action of certain toxins and the localised psychic results thus caused. He contrasts the stimuli which cause mental depression with those which produce exaltation. He believes hallucinations are not primary, resulting from direct stimulation of the sensory centres or the perceptive centres, but result always from excitation of the "representative centres and associations" in the cortex by means of the connecting fibres between the various sets of centres. He points out that systematised and fixed delusions always centre round an instinct or a fundamental passion of human nature, *e.g.*, delusions of persecution round the passion for possession, delusions of grandeur round the sense of our personality and value, etc. As to "fixed ideas" he considers the affective, and not the volitional theory, the most reasonable. He maintains that such theorizing is necessary if

progress is to made and is "a necessity of every scientific mind."

The etiological chapter is also well worth perusal. He begins with intoxications and infections, endogenous and exogenous, pointing out how the "one may follow the other through pathological necessity," instancing the effects of alcohol, intestinal intoxications, the toxins of the secretory glands, the thyroid, and the parathyroid —all of these often producing both a primary and a secondary effect, the latter being the one which commonly causes the mental symptoms.

Exhaustion and fatigue are well treated and the clinical importance of the oxygen molecule in the "biogenes." The relation of the hydrocarbons to the nitrogenous materials in the process of the nutrition and in the action of the neurones is dwelt on. The respective funotions of the cell body, the Nissl substance, and the association fibres, and how they may come in as explaining normal and abnormal psychical facts are treated of most suggestively. The special resistiveness of the nerve centres to exhaustive and starvation processes is touched on. The brain is the last organ to lose weight in starvation, indeed it loses very little. He says "there can be no doubt that the toxic facts should be taken into consideration before any other" as destructors of nerve tissue and as stimuli to abnormal central action. The "psychic causes" of insanity he treats cautiously and almost sceptically. He looks for the ultimate and real cause as "an internal, unknown but organic anomaly in the brain constitution."

His subtle mind distinguishes between an "anomaly," a "predisposition," and a "degeneration." He defines each according to his own theory of its nature. He craves for an external cause for a "predisposition."

He discusses at great length the rôle of Heredity in mental disease and begins with a fair recapitulation of what can be said for and against the transmission of

acquired characters. He admits the specific and continuous dynamic influence of every organ and every tissue on the germ plasm. He admits the transmission of the " functional hypertrophies" into normal stable growths in successive generations. Those admissions are about all that the psychiatric believers in the transmission of certain acquired characters in mental disease ask for. On the whole Lugaro tends to minimise the hereditary factor in mental disease. He speaks of it as being "an acquired phenomenon subject to the law of evolution as are all the means of adaptations" and that it must be " perfected gradually." He thinks his hypothesis " reconciles completely " the controversies between those who admit and those who deny to heredity the transmission of acquired characters. Neither side I fear will be likely to agree to this. He will not carry psychiatric opinion with him either when he says that " injurious fortuitous varieties which we call degenerations do not exist to be perpetuated" and that degeneration therefore is a "disease of the stock, but is a disease that is curable." Surely this statement should have been conditioned. He tries to explain many so-called hereditary neuroses by ordinary pathological law. He says a " similar heredity " cannot be maintained with any force excepting in the cases of hysteria, dementia præcox, and the so-called manic-depressive psychoses.

Under nosology he writes " the same cause can give rise to a variety of groups of symptoms " and " divers causes can give rise to very similar if not identical symptoms." He deprecates therefore a symptomatological nosology. He does not admit that a " syndrome "—that is a correlated group of symptoms—is a proper basis for a classification of the psychoses. We must look beyond the syndrome and even the cerebral lesion to the organic processes which produce them—to the primary causes which exist

outside the organisms. He only recognises certain forms of idiocy, cretinism, alcoholism, general paralysis, and senile dementia as "clinical entities." He does not believe in an "epileptic insanity" or that a "real idiopathic epilepsy" exists. Those statements give the key to his nosological views. "Manic-depressive" insanity he treats lightly. "Dementia Præcox" he treats with more respect but looks on it as a transitory clinical generalization, and thinks its more severe varieties indicate a pathological change in the association systems of inter-neural fibres, the projection system being intact. He however gives Kraepelin the greatest credit for his clinical and experimental work.

"Knowledge of mental diseases, in the strict sense of the word, can only be attained by the progressive interrogation of psycho-pathological data along with those of general pathology, of etiology, of physiology, and of normal and pathological anatomy. It is only in this way that mental diseases will cease to be mere enigmas and psychiatry will become, as it ought, a recognised branch of general medicine."

In his "Practical" chapter he propounds the enigma "In no case does the treatment of a disease determine its cure." But he makes a lofty defence of treating well even the idiot and the dement. "Civil society which respects the incurable portion, though useless and costly, respects itself."

He eulogises prophylactic measures but is sceptical as to the efficiency of restricting marriage among tainted families. His views on criminology in relation to mental defects and disorders are not those of the "Italian School" which he treats with some scorn. He carefully endeavours to see the point of view of general society and the judges. Some parts of the "conclusion" should have been in the preface. It is wise and explanatory.

I feel that I have been able to give but a poor idea of the merits and character of this remarkable book which I know will be a valuable addition to English psychiatric literature. We Britons needed such a clear, logical, and illuminating treatise. Even its abundant theorizing will stimulate us to think. It is wider in its scope and more philosophical in its methods of treating the subject than any book of our own. In short, it exhibits more of the scientific spirit. All our alienists and most of our physicians will do well to peruse it.

Author's Preface

Few scientific subjects are less adapted for presentation to the general public than psychiatry, and very few, on the other hand, excite so much interest and so much curiosity.

The problem of the relations existing between mind and body has always been a source of anxious interest both to the cultured and the general public, and the mystery of the subject is still greater when the diseased mind is taken into consideration. But if the interest and the curiosity are great, the difficulty of obtaining a clear conception of the particular problems to be resolved and the means by which we may hope to accomplish this end is even greater. As a result we find this field of inquiry is dominated by the most unreasonable prejudices.

Simple minds are contented with mystic solutions, with an illusory play of words. Men of science investigate with an open mind, and are satisfied with their work which if slow is certainly progressive. But the mediocre mind wishes to know everything without much trouble, and has a strange longing for prompt and safe formulæ. Such men are the predestined victims of prejudice and scientific quackery.

Psychiatry has been brought to the public notice principally by notorious law-suits, by articles in political journals, by the presumptuous comments of the dilettanti, by the boastings of ambitious professional men, by hunters after notoriety, who, posing as revolu-

tionaries, as apostles, as disappointed martyrs, express opinions which are neither original nor valuable, but are put forth with that confidence which one generally associates with ignorance. With the aid of a few anthropological measurements and biographical anecdotes they sometimes pretend to be able even to reconstruct a psychic personality and to provide a common basis for all the problems of psychiatry and criminology. But all this has nothing in common with the serious and conscientious investigations which are carried on quietly in the clinics and in the laboratories. And seeing that the public know nothing of these researches it is not to be wondered at if there is a tendency on its part to look on all that appertains to psychiatry, the most prudent clinical opinion as well as the answers of the sibyls, with a scepticism not unmixed with scorn.

Although the task is an arduous one it is necessary, and it is a duty to combat the stultifying effects of these misconceptions which become more dangerous than ever when they are clothed in scientific language, and to attempt to delineate the genuine objects of the science in a brief and honest survey.

I do not propose in these pages to give a full exposition of the present state of psychiatry. I shall not, therefore, make a list of the data which are, or are presumed to be, definitely settled, nor shall I offer any conjectures—bold but vague—on the results which this science may hope to attain in the distant future. I believe that it will be more advisable to indicate the questions which are being actively discussed at the present day.

Therefore, without boasting of the conquests already achieved by the science, and without attempting to foretell what the future may hold for it, I will attempt to point out the practical programme of the work of to-day and to give some hint regarding the programme of to-morrow. The past and the future of a science are

included in the living problems, in the practical means of solving them and in the hypotheses which sound the unknown and in it discover new questions. He who comprehends these problems, he who appreciates this programme of work will really understand the position and the aims of the psychiatry of to-day, and will succeed in preserving himself from the sterile scepticism of the ignorant and the bold but futile enthusiasm of the omniscient.

ERNESTO LUGARO.

SASSARI,
December, 1906.

Translators' Note.

During the past few years there has been published in Italy a series of works dealing with various scientific subjects, but more especially with biological studies, which includes the results of research done by eminent men in many countries. The present volume on the "Modern Problems of Psychiatry" by Professor Lugaro has recently been added to the list.

Since it has become known that influences arising outside the nervous system play such an important part in the production of the changes in the brain which form the anatomical basis of mental disorders, the problems of psychiatry have been found to be immensely more complicated than had formerly been supposed. A knowledge of the principles of biology and the application of the sciences which have a direct or indirect bearing on the etiology of all diseases is now felt to be absolutely necessary for the scientific investigation of this subject.

In his volume Professor Lugaro has approached the subject from this broad scientific point of view, and has not only indicated many of the problems which have to be solved, but also the lines along which investigations must be conducted in order that "psychiatry may claim a place among the sciences and become a part of general medicine."

The many text-books on the subject of insanity which we already possess, deal almost exclusively with the clinical aspect of mental diseases, and we know of no work in the English language which treats of this

question from the scientific, practical, and social sides so clearly and so thoroughly. The work appears too at a time when the question of the necessity for the better teaching of the subject, for the carrying on of research in our asylums, and for a modification of the treatment of the insane and the criminal is becoming recognised throughout the country.

For these reasons we asked Professor Lugaro to allow a translation of his book to be made, and we have to thank him for so readily acceding to our request.

We have to thank Dr. Clouston for his ready compliance when asked to introduce this work to British alienists. The interest which Dr. Clouston has taken in all the scientific, administrative, and social aspects of mental disease, and his many valuable contributions, require no mention here. His appreciative and critical "Foreword" speaks for itself.

Our cordial thanks are due to the Manchester University Press for their offer to publish this volume and for their courtesy throughout the preliminary arrangements.

In conclusion we are grateful to Drs. Crompton, Paul, and Starkey for much assistance in the correction of the proof-sheets.

DAVID ORR, Prestwich.
R. G. ROWS, Lancaster.

July, 1909.

Translators' Note to the Second Edition.

In issuing this second edition of Professor Lugaro's book, we have not thought it necessary to make any radical alterations in the text. We have, however, taken this opportunity of making a large number of small changes, including the correction of several errors, typographical and other, which appeared in the original issue. We wish to express our cordial thanks to all those persons whose reception of the first edition has made a reprint necessary.

DAVID ORR, Prestwich.
R. G. ROWS, Lancaster.

April, 1913.

I. General Introduction

Step by step as a science progresses the mass of knowledge composing it increases, the knowledge of the single items becomes progressively more accurate, and the methods for obtaining new results become more complicated and specialized. Therefore the efforts also of those undertaking research must be concentrated, that is to say narrowed and specialized, otherwise the specialist will be wanting in technical capacity and in the means of carrying on his work with the best possible results.

In practical applied medicine technical perfection is naturally of the highest importance. The distinction between general medicine and surgery has arisen from a series of improvements and technical innovations. Other specializations are evolved from the diversity of systems and organs into which the human body is divided: thus neuropathology, the speciality of the eye, and gynæcology have arisen. Psychiatry, more than any other medical speciality owes its origin to practical requirements. It has not been separated from the rest of medicine by any particular maturity of doctrine or for anatomical reasons, but it commenced to establish its individuality contemporaneously with the recognition of the social necessity of isolating the mentally afflicted, at which time its relations with medicine were strongly discussed or flatly denied. Just as epidemics determined the necessity for pest-houses, even when the cause of the contagious malady was still unknown, so in times when scientific psychiatry had no existence, asylums arose either as annexes, or as wings of prisons more or less modified.

The gradual approximation and annexation of psychiatry to medicine is the effect of a slow, tedious, and later evolution, through historical phases stamped by special scientific tendencies, which if they do not actually constitute chronological periods in the strict sense of the word, serve at any rate to mark the logical development of this science.

At the beginning, the principal task, a rather more arduous one than may appear at the present day, was to make known the morbid nature of insanity, to demand the construction of asylums, to separate the insane from criminals, and to remove them from all rough usage. This is what might be called the dawn, the *humanitarian* period of Chiarugi and Pinel.

The first scientific investigations were naturally directed with strong preference towards the psychic phenomena, the most apparent manifestations of insanity. At that time it seemed obvious that in diseases of the mind everything must be developed within the sphere of psychic phenomena: the causes were psychic, the symptoms psychic, the treatment psychic; and often a most accurate, excellent, and thorough analysis of the symptoms was made. In this psychological direction Esquirol, Guislain, and Baillarger excelled; and the tradition of their work still has its influence.

A new tendency appears before us and a new period unfolds with Morel's doctrine of degeneration. According to this doctrine the somatic factor assumes a high degree of importance and so psychiatry comes closely into line with medicine. Organic causes, above all of an infective or toxic nature, lower the tone of the organism, injure its most vital organs, and disturb the delicate mechanism of procreation. The offspring degenerates; the individuals carry in their person the stigmata of degeneration from birth, and evidence of these is seen in external morphological aberrations,

lesions of internal organs, and above all in departures from the normal in the nervous system. At the same time one cannot exclude the possibility of recovery or regeneration; but for the most part the evil is rapidly accentuated; in a few generations the reproductive capacity is lost, and the stock dies out.

This doctrine was thoroughly scientific however excessively pessimistic and immoderate as a scheme. But it was modified later and became too narrow and incomplete. This new tendency, initiated by Moreau de Tours, which attained its highest development with the work of Lombroso, sprang up and grew under the influence of the study of biological heredity, of atavism, of the evolution of living species and man. According to it, degeneration may be interpreted as a kind of biological involution; insanity is an anomaly, but not atypical; an insane person is somewhat of a variety—possibly even aberrant—of the human type, comparable to an inferior psychological type pre-existing in the long and multiform genealogy of human civilization.

This *anthropological* doctrine of insanity, although strongly supported in Italy, is a thing of the past. The general tendency, which to-day is becoming increasingly stronger, aims at interpreting all mental disturbance as a pathological manifestation, and welding psychiatry with general clinical medicine. Under the guidance of pathological anatomy and of the new general pathology that is coming to light with regard to the nervous system we now investigate the genesis of the organic processes which in a diseased brain develop either through direct action or through the indirect influence of primary lesions altering the function of any of the other viscera. The psychological mechanism of mental diseases, the final and more visible expression of the functional perversion which undermines the brain—so sensitive to impressions—often takes a second

place; and instead, the study of the causes—which taken as a whole do not differ from those of all other diseases—combined with that of the pathogenetic mechanism is the primary consideration, a study which alone can provide data for that treatment and prophylaxis which form the practical objects of medicine.

Thus psychiatry has delayed for more than a century before transforming itself into a solid branch of medicine, a position long occupied by other studies. It is useless to disguise the fact; even to-day psychiatry is, as a science and art of medicine, very young. He whose custom it is to indulge in fatuous enthusiasm and pretentious language will possibly, at every inaugural discourse—either on the occasion of a congress in psychiatry or at the opening of a conference—hail with a flourish of trumpets the tremendous progress made and the results accomplished, and extol the pre-eminence of psychiatry over other branches of clinical medicine; but there can be no doubt that the progress of psychiatry has been slow, laboured, and rather unsatisfactory. This science of psychiatry can, however, prove an attraction to him who feels the fascination of difficult and deep problems; but its results are far from giving that satisfaction which one obtains, for example, from surgery or from the study of infectious diseases. It is one of the noblest as a science, the humblest as an art.

This depends on the fact that the study of mental diseases touches upon and embraces all the most intricate problems of biology and medicine, and contains many others which belong to it exclusively. Besides this, the intimate contact which psychiatry assumes with the most varied doctrines and with the most diverse fields of social activity, raises a host of current scientific, religious, metaphysical, philosophical, and ethical prejudices against it, which paralyse its efforts and hamper its progress.

The psychic symptomatology, which characterizes

mental diseases, is rich and imposing, but by it alone we learn little or nothing of the objective phenomena which determine them; while in all other diseases the subjective phenomena—which here are simply the normal reactions of the brain—form a most valuable guide in the investigation of the objective alterations which are the essential part of the disease. But the investigation of subjective alterations must invariably be the starting point from which to try to arrive at a diagnosis.

With this aim in view, it is not sufficient to merely group accurately and analyse the psychic symptoms; in addition we must find out their pathological signification, as signs of functional disturbance. In order that psycho-pathology may acquire really practical value, it is necessary then for it to go hand in hand with normal psychology. But we must not look upon normal psychology as a purely introspective analysis. Such an analysis, as we shall see, is inadequate to make clear to us the determinism of the process; to know which is precisely our concern. On the contrary, the normal psychic phenomenon must always be examined in relation to its anatomical and physiological conditions, that is to say the organic process which is its essential basis.

It is just here that new difficulties arise. The anatomical and physiological problems which concern the nervous system are of exceptional complexity. Anatomical analysis has accumulated an enormous mass of facts, but it is yet far from being complete. The general structural plan is now clearly delineated, but as to the structure of every single part and the connections of one with another innumerable problems still remain unsolved; and with every discovery in technique which permits of refinement in analysis we are at once shown a complexity of relationships greater than that previously foreseen.

The cellular theory rendered obvious very many problems in physiology and pathology. But the nervous system, on account of its anatomical complexity, was almost half a century late in coming under the influence of this theory, and our knowledge that it is composed of a collection of cellular units—*neurones*—is little more than ten years old. These elementary organs are of very singular form, because even though possessed of a microscopical cellular body—like other cells of the organism—they are provided with delicate and immeasurably long prolongations, some of which are destined to receive stimuli, and one possessing certain particular characters is reserved for the discharge of the dynamic energy developed in the cell's interior. The doctrine of the neurone was from its birth the subject of much and varied criticism, there were times when it was the vogue, others in which it was declared dead, and only to-day it emerges from the controversy stronger than ever.

The anatomical facts noted up to the present already give us an idea of the difficulty in understanding the functional mechanism of the nervous system. The basis of the physiology of the nervous system was, for a long time, simply that derived from experimental destruction or excitation of macroscopical parts accessible by vivisection. But if every morphological fact must present itself to the physiologist as a problem to be solved, how many and how complex are those provided by microscopical anatomy! We are still far from being in possession of a general physiology of the nervous elements from whose principles we should be justified in drawing inferences regarding the function of single units; to-day these are only represented by a mass of hypotheses. The individual morphological types of nerve cells have only suggested, so far, many vague conjectures of a general nature; but if, on the one hand, these types are innumerable and appear inexplicable, on

the other, they are sometimes in certain organs—in the cerebellum for example—so clearly distinguished by some particularly exclusive shape and situation as to open up problems of more promise to physio-anatomical research. Similarly the cerebral cortex—the principal and perhaps the sole seat of intelligence—presents in its various portions not a few homologies of structure. These are only general however, and the constituent elements vary from region to region in particular characters, in number, and in arrangement, thus imprinting special features on every region of the cortex. If one considers then that function is not determined by the structure of the nerve elements alone, but in addition by their individual connections, it is legitimate to conclude that in the nervous system there are no two cells nor any two fibres possessing absolutely identical function.

Pathological anatomy which in other fields of pathology yields fundamental conceptions even on naked-eye inspection, in the case of mental diseases can neither provide clear data for clinical application nor be itself established without minute and painstaking microscopical research. And very often the latter demonstrates to us, in agreement with experimental data, that certain slight and transient influences, though not going the length of imprinting any sign of their passage upon even such a delicate structure as the anatomical network, are still capable of inducing very grave functional disturbance. Besides, when the microscopical lesions are evident they are not always found uncomplicated, but on the contrary are often masked and pushed into the background by other much grosser lesions which have nothing to do with the mental disease, but depend instead upon other diseases or upon the pathological complications incidental to death.

The way in which morbid causes act is in general very far from clear. The connection between extrinsic action

and the cerebral lesion is almost always a very indirect one. Whole chapters in physiology and general pathology had to be written before certain distant relationships between disturbance of brain function and lesions of other viscera were discovered. The functional insufficiency of a shrunken gland in the neck causes the syndrome of cretinism. Slight but chronic lesions of the kidneys can determine conditions of stupidity, temporary loss of speech, and violent attacks of confusion and agitation. A febrile malady occurring in infancy, though transient, attracting little notice, and passing away almost unobserved, can ruin the brain beyond repair. The effects of this may either manifest themselves as moral and intellectual defects of every degree, or as epileptic convulsions which may appear after many years, and by their repetition progressively destroy the mind. An infection, an habitual intoxication of the parents, a maternal disease during pregnancy, can determine perversion of development, which though so slight and uniform as to be quite unobservable at birth, comes to the surface with the progress of years in the shape of unexpected failures of certain fundamental functions of intelligence, of eccentricity of character, and of perversion.

The problem of the causes of mental diseases is perhaps the one most subject to the influence of prejudices on account of its still being wrapped in obscurity and because it involves the vexed enigma of the relation between mind and body, between consciousness and organic cerebral processes. We leave out of the question those not conversant with psychology who constantly regard insanity as the exclusive effect of mental suffering, of disappointments, and of excesses; and also those religious persons who ascribe it to depravity or the punishment of God. But scientists and philosophers are not yet convinced that to seek for *causal relationships* between consciousness and the

objective world is a mental exercise which is as futile as it is wearisome. To simply demonstrate a parallelism between certain organic cerebral processes and certain states of consciousness—and beyond this it is impossible to go—is, to say the least, unsatisfactory; and while, on the one hand, an attempt is made by means of a purely verbal monism to identify two things which in our minds we regard as clearly distinct, on the other hand, we fall into just as serious a dilemma if we admit the existence of a subjective psychic world, different in nature and obeying laws differing from those of the material mechanical world, but which still has power to mechanically interfere with it. Even though this supposed interference is admitted to be trifling, scarcely recognisable, and confined to directing or impeding an action, it involves an obvious violation of natural laws.

The range of other prejudices is more strictly scientific. There is the excessive prejudice of psychologists who would find at all costs a link or causal relationship between mental phenomena which succeed each other in an incoherent and disorderly fashion. Absorbed in meditation on the more apparent phenomena of mental diseases, these observers, empirical in their methods, have a tendency to neglect to a very great extent the substratum of organic phenomena in which the true determinism of the disease lies.

Then there is the prejudice of the anthropologist, fenced round as he is by the doctrine of descent, who sees in insanity a systematic involution of the human personality, a reversion to a remote ancestor, by which the madman is comparable to a child, a savage, or a brute. He clings to this view even in the case of a patient who cannot be compared with lower organisms, or with organisms incompletely developed but sound.

Mental diseases, especially to the layman, appear to be much more complex than other diseases, and often as something altogether strange. In the latter the genetic

mechanism, though not manifest, is surmised; one knows of, or supposes the existence of, a pernicious action of external origin, to which the organism reacts either to combat it successfully or succumb to it; thus one sees that in the conception of disease objective organic action occupies a foremost position. In mental disease it is somewhat exceptional for the organic factor to be apparent; it is easily perceptible only when insanity is associated with marked disorders of growth, of development, of gait, such as are found in idiots and in cases of paralysis. But much oftener the disease appears as a biological disturbance, an abnormality in conduct and behaviour, while at the same time the nutritional processes are, or appear to be, intact: for example, the most essential mechanisms for adaptation to the surroundings are altered; reactions to the briskest stimuli are wanting; the power of defence against external agents or the taking of food is rendered impossible; even the instinct of self-preservation may be perverted. Sometimes even these changes are not present; the organism of the insane person is adapted to the elementary conditions of an autonomous life, but that aptitude for adaptation which is necessary for social aggregation is defective or perverted. These last forms of insanity, which depart from the normal least of all, may show innumerable gradations, so that it is very difficult to draw the boundary line between what is normal and the slight aberrations recognised as such but tolerated by society. These debatable forms which constitute a link between the insane and the normal subject are exactly those which make the question of penal responsibility intricate and controversial. And so it is within this debatable zone that theoretical principles and practical criteria come into conflict. We have on the one hand objective criteria which—as is readily admitted by all—would be applicable to anyone obviously insane, as they would be to an unconscious

mechanism; while on the other hand there is the subjective criterion of moral responsibility inspired by the doctrine of free will which is considered to be the standard for judging the actions of persons of sound mind.

From this rapid summary we see that psychiatry not only enters into intimate contact with all the fundamental sciences of medicine and biology in general, but also touches upon the social and moral sciences. On all it imposes problems, from all it requests data. And rarely are these sciences sufficiently advanced to solve those problems or to supply those data.

There is no doubt that all sciences have a reciprocal connection and each advances by taking advantage of the progress made by others. Special sciences are to be considered as theoretical structures, masses of doctrines artificially isolated. In practice it is not possible to limit one's attention to one single branch of a complicated subject, and all the great pioneers of science have dived deep into two or more different branches of knowledge with equal success and skill. There is a physics and a chemistry but pure physicists and chemists do not exist. Anatomy can be separated from function, but the anatomist must be conversant with the latter. The physiologist does not understand his science without anatomy. But in no science do so many sciences dove-tail into each other as in psychiatry.

Therefore the alienist must—as much as the time at his disposal and his individual capacity permit—take an active part in work developing in neighbouring fields of research, cultivate other sciences and help them to progress, in order to further the progress of his own. This justifies the many-sided activity which the young alienists display at the present time, and which carries with it sometimes the reproach of studying everything except psychiatry, of analysing everything

save the patient. The mere study of the psychology of diseases of the mind, to which psychiatry should be reduced according to some, is a necessary study but by itself ineffectual and sterile. Alienists are bound to leave their own field, fashion and solve for themselves their own special problems in the other sciences. Only in this way can they contribute to the creation of a complete psychiatry.

II. Psychological Problems

The mistaken opinion—which has been held so long that it is now almost accepted as an axiom by the cultured as well as by the ignorant laity—that insanity is due especially to causes of a psychic nature, to prolonged overaction of the intellect and of the will, or to violent emotions, and that it may almost be considered as the ruin of a machine which has been forced beyond its capacity, was for a long time accepted without discussion even by alienists. The passions were usually regarded by the general public as a dangerous component of the mind, dominating it and sometimes driving it into a state of delirium.

Amongst those who see in insanity a strictly pathological condition, a disturbance which is determined by the most diverse causes—such as coarse or fine anatomical lesions whose effects are greater than mere functional disturbance—not a few endeavour even now to interpret the phenomena of insanity according to the rules which govern normal psychical processes. They maintain that they are able to explain psychologically the acts of the insane by means of the same criteria which they employ to interpret those of the sane; and sometimes ignoring realities and abandoning themselves to fantastic conjectures, they attribute the most enigmatical and illogical manifestations of insanity to a schematic and more or less logical internal determinism.

At the least they would make it appear—and this is the general tendency—as though the laws of pathological psychology are simply corollaries of the laws of

normal psychology, and that even in individual cases the variation of one psychological factor produces an abnormality of all the others. In every mental disturbance it is necessary to distinguish the *direct* result of the morbid cause from the *indirect* effect which follows the action of the primary disturbance. The secondary disturbance naturally develops according to normal laws and in organs relatively normal, because it is not occasioned by the direct action of the morbid cause.

In many cases the justice of this conception is evident. Who would dare to deny that in a case of paranoia the delusional interpretations of all the particular incidents of life are logical, coherent consequences of an erroneous emotional preconception, which forms the basis of an abnormal premise, and this in turn becomes the nucleus of the psychopathic disturbance? And who does not see that the delusions of the melancholic are inspired by a systematised pessimism which has its root in a morbid depression of the affective tone? There is no doubt that these attempts at a psychological interpretation form a useful work preparatory to the determination of the fundamental basis of psychical disturbance.

But by this we do not get beyond a pure psychology; and psychiatry, if it should thus be understood, would be reduced to a mere classification of symptoms, to a description of psychopathic syndromes, but not of morbid processes whose intimate organic mechanism, the objective determining factor, is capable of being known. Psychological classifications must find a counterpart in cerebral pathology, which will provide a critical comparison, a definite reason for preferring one to another. Let us take as examples two of the most typical systematised schemes of psycho-pathology: that of Ziehen and that of Wernicke. The first is limited to a purely psychological study which is rigidly based on the doctrine of association; the interpretation of

Wernicke, on the other hand, is founded on the psychopathology of language. This certainly does not depend on purely introspective observation, but springs directly from clinical and anatomo-pathological analysis. Of these two the latter would certainly be preferred if it did not suffer from such extreme one-sidedness, in that it applies indiscriminately to all psychic functions a scheme which is suitable to only one of them.

These purely psychological schemes, even if they clearly lay before us the successive steps in mental disturbances, teach us little or nothing by themselves about the nature of the primary disturbance, a knowledge of which is necessary in order to understand the essential mechanism of insanity. But apart from this there is another question to be considered. To what extent can the psychological examination of diseases of the mind, an analysis of the connection which exists between the various psychopathic phenomena and the causes which determine the sequence of their appearance, give us any information regarding the determinism of the insanity? What value do psychological laws possess when applied to simplified schemes of mental pathology? We know that they are drawn from normal psychology. But to what extent are they valuable even in normal psychology? It is necessary, therefore, before proceeding further, to subject the determinism of normal psychical phenomena to a critical analysis.

Let us first consider what is to-day the conception of *determinism,* and more particularly the conception of *cause,* which is its fundamental element.

The conception of cause has undergone repeated changes. There is a primitive, anthropomorphic, animistic conception of cause, according to which all the phenomena of the external world are likened to the results of human action, and which therefore seeks to find their antecedents in so many voluntary

actions. This primitive form has by no means yet disappeared; it is the salient feature of all religions and it taints all the philosophic systems which do not stand in clear and evident contrast with the religions.

There is a second form which may be described as *empirical,* which sees the nexus between cause and effect in a certain constancy, relative or absolute, in the sequence of phenomena. This is a form which is very frequently applied to the common incidents of every day life, and for a long time it was the only method employed even in the most rigorous scientific investigation.

The scientific concept of causality is of quite recent origin. It has been evolved along with the mechanical conception of the universe, but it has been clearly understood only since it became possible to formulate the law of the conservation of energy in all its various applications, which by ultimate analysis have been reduced to one type, viz., the mechanical. According to this the *quantitative relation* becomes the inflexible law which regulates all the alternating phenomena of the objective world, and causality reduces itself to the necessity of the succession of events according to mechanical laws.

A synthesis based on mechanical data, suggested by physical analysis, gives to causal relationships the greatest uniformity and precision, but from one point of view, it does not remove from them the empirical character of a simple statement of fact. Mathematics, applied to mechanics, presents to us the successive phenomena as a series of equivalent terms, but the law according to which these series unfold themselves cannot be reduced to a mathematical principle; it can be formulated only empirically. Mathematical laws pay no attention to the principle of the absolute irreversibility of mechanical phenomena, and hence of phenomena in general.

This principle has a universal application, although,

if regarded superficially, it may appear to be subject to innumerable exceptions. The law by which energy tends to distribute itself uniformly, and to thereby rectify every disturbance of dynamic equilibrium, admits of no exception. From the mechanical point of view we cannot contrast *evolution* and *dissolution;* between these two types of active phenomena there is no objective difference, but only a subjective difference of point of view. According to the classical definition of evolution, we describe as " evolutive " those phenomena which are exhibited in a mass which loses energy, as " dissolutive " those which are presented by a mass which acquires energy; but the passage of energy from a mass to its surroundings, or from the surroundings to a mass, or even from one mass to another, is always regulated by the tendency towards dynamic equilibrium. The idea of the irreversibility of phenomena has become with us a synthetic intuition which manifests itself in the firm conviction that time passes inexorably and does not return.

Mechanical determinism, the highest development of physical laws, maintains therefore in its general lines the character of an empirical law. And it could not be otherwise. Empiricism assumes the existence of a fact even though it cannot be traced to any known law of wide application. Every general synthesis which is not fully established, must, at least provisionally, be characterised as empirical. And if we consider that conception of causality to be scientific which is implied in the theory of mechanical determinism, it is because such a conception embraces and combines all the laws which are derived from physical investigations, and which, associated together in it, acquire the value of a systematised scientific scheme.

But if that be granted, can the conception of mechanical determinism be applied to psychical

phenomena when they are considered from their *subjective* aspect? Evidently not. There does not exist in the field of consciousness any common factor to which we can reduce all the constituent elements which appear to differ so much one from another; there is no common denominator, comparable to motion in the objective world, which renders exact comparative measurements possible. Subjective phenomena, states of consciousness, do not appear to us as though they could be reduced one to another; and this is true not only when they belong to essentially different categories, but also when they are of the same order. It is not possible to eliminate the qualitative distinction which exists, for instance, between a sensation of red and one of bitterness, or even that which we recognise between the smell of a lily and the perfume of a gardenia. And this irreducibility of qualitative characters renders any exact quantitative comparisons impossible.

There is no doubt, however, that even in the appreciation of subjective phenomena the question of quantity is taken into consideration. We know that we can recognise many degrees of intensity, extending over wide limits, of a given sensation—for example, a perfume or a sensation of pain—without appreciating any marked alteration in its qualitative character. We speak always of a strong or weak sensation, of a slight or intense emotion, of clear or indistinct perceptions, of vague or vivid memories. On the other hand, how can we possibly conceive of an objective quantity unless some states of consciousness furnish us with a corresponding series of symbolic terms?

But there is a great gap between appreciating quantitative differences and taking their measure. In order that measurements may be made it is necessary above all that there shall be a qualitative identity between the opposed terms. This identity cannot exist between states of consciousness because they differ qualitatively. We

may be able to affirm that two sensations of red are equal or at least indistinguishable, but we should be somewhat embarrassed if we had to determine what must be the intensity of a sensation of pricking which would be the equivalent of a given sensation of sound or smell. And even between sensations belonging to the same category and equal qualitatively it is only the judgments of *identity* which can possibly assume an exact form.

Now let us anticipate an objection. The world around us can become known to us objectively only through our consciousness; it is a construction of our mind whose starting point always depends on the data provided by our senses. If therefore it is possible to measure objectively, it must also be possible to do so subjectively, because our representations of the world and of the metric relations of things in it are subjective. That may be so; but when we measure we do not compare sensations one with another directly. We have reduced the representation of the world to a mechanical standard, and all measurements to *measurements of space*.

In order to measure objective phenomena we transform even intensity into *extension,* and we therefore have always to deal with *spacial perceptions*. Now spacial perceptions have this peculiarity, that they can be considered independently of the qualities of the object and they can be appreciated simultaneously. In this way every spacial comparison can be reduced analytically to a group of judgments of identity which alone allow of any degree of exactness; and measurement consists in a certain number of such judgments. But we cannot figure to ourselves qualitative differences of sensations as differences of space nor can consciousness be defined in terms of extension.

Psychophysics, which pretends to have succeeded in establishing quantitative relations between various sensations, between different states of consciousness, has, as a matter of fact, only attempted to define the quantita-

tive relation existing between sensation and stimulus; this is not a real subjective comparison. Nothing of very great importance has sprung from it excepting the law of Weber, of which that of Fechner is simply a superfluous extension. But these have really very little to do with subjective psychology, because the law of Weber in all probability depends on a number of physical and physiological objective factors.

If then it is not possible in the subjective field to reduce quality to quantity and to compare it by means of measurements, as may be done with objective phenomena, or to establish a series of quantitative equivalents in order of sequence, it is useless to hope that we shall be able to find in the field of consciousness itself a deterministic mechanism of psychic phenomena analogous to that met with amongst objective phenomena.

It is for this reason that in dealing with psychology our attention has been focussed almost entirely on the empirical conception of causality. When we speak of *psychological determinism* we recognise, it is true, that there are objective cerebral processes determined according to the laws of the objective world which correspond to the phenomena of consciousness; but the opinions which are held at the present day regarding these processes are based almost exclusively on subjective observation and elaboration. Hence has arisen "*sensationalism,*" the first and simplest formula of the psychology of observation. Hence also has originated associationism and other more recent and complete theories. But no one of these interpretations of the psychological mechanism can claim to be deterministic in a strictly scientific sense. If we speak of the association of ideas, we enunciate certain vague laws which suggest a number of possibilities in the course of the process of ideation, but which do not allow us to foretell with any certainty what the result will be. And when we refer to the conflict of

motives which precedes any given line of action, we invent an explanatory metaphor, but we convey no precise idea of the individuality or the force of the separate combating factors. As a matter of fact the train of thought is anything but constant even in the course of those ideas to which we are most habituated. There is always a something fluctuating, a something we cannot grasp, in a current of thought.

States of consciousness, which, according to our metaphor, dispute the field of attention, the motives which oppose one another in determining an action, have an oscillating value which frequently sinks to zero, to unconsciousness. On the other hand, the mechanism by which the states of consciousness follow one another cannot always be expressed in subjective terms.

In discussing this mechanism the question naturally arises as to how we are to explain ideas and memories, not from the point of view of their reality, but of their existence in the latent state. Some would represent them as a something continuously active, in a state of vigil although subconscious, awaiting a suitable opportunity to emerge from the realm of shadows. But others refuse to accept this psychological contradiction of terms. A state of consciousness, however feeble, is always conscious; and if we suppose that at a given moment it is eclipsed by another which is more intense, it ceases to be conscious, or rather it ceases to exist. The subjective psychological explanation of latent ideas is therefore entirely fallacious. It is more probable that a latent record consists in a trace or an imprint, which is preserved in an anatomical unit, in a mechanism which is generally inactive, but ready to enter into action in response to any stimulus which reaches it at an opportune moment. As a result of this view, we find that there is secretly introduced into the mechanism of introspective psychology a purely objective element, one of many which might lead to much equivocation in the consideration of the *psychology of unconscious states.*

But there is still another reason why this sort of psychic determinism may not be compared to the determinism of objective phenomena. Physical determinism demands as an essential element the conception of *continuity*. Phenomena succeed one another by a process of transformation without any break in continuity; all phenomena are reduced to motion, which is developed in space and time, and their chief characteristic is continuity. States of consciousness, on the other hand, appear to us to be entirely discontinuous. Even if there exists amongst them a regular sequence, we do not derive therefrom any sense of continuity. The simple qualitative differences, which, as we have seen, cannot be reduced one to another, determine a clear separation between one state and another. It is evident then that the current of thought is not continuous; sleep, a swoon, an artificial narcosis form lacunæ between various periods of consciousness; further an unforeseen distraction or an unexpected impression is sufficient to entirely change the course of our ideas; and even when no strong stimulus from the outside world intervenes, the course of ideas is vague and fluctuating. Our ordinary thought is far from having the coherent and incisive character of a literary work or of a discourse, but resembles rather a lucid dream, a reverie.

We have already seen that because we have no exact standards of measurement it is not possible to demonstrate any quantitative values corresponding to successive states of consciousness. But it appears to us that it is impossible to conceive of the existence of such corresponding values, even if we do appreciate in a rough way the degree of intensity of the states of consciousness which succeed one another. How can we imagine that a psychic state is the dynamic equivalent of an antecedent state, when we see that a word heard by one individual can determine in him an intense psychic reaction, which may lead to a series of actions,

whilst in another it may pass almost unheeded, and to him is a mere accidental noise? In such a case it is evident that the sequence of states of consciousness cannot be explained without assuming the intervention of some latent predispositions, of some traces which have been left by antecedent experiences; in other terms, without the intervention of a purely objective factor, which is altogether extraneous to our consciousness.

In no way then can we from the point of view of determinism compare the succession of states of consciousness with the sequence of objective phenomena. We may recognise certain relations, which appear to us to be almost constant, and we may formulate from them certain laws; but we are not in a position to regard states of consciousness as the product of reciprocal transformations, according to the principles of continuity and of dynamic equivalence as they prevail in the objective world. The law of determinism in its strict sense must be looked for elsewhere, that is, outside our consciousness in the objective world.

Innumerable data, which have been collected by observation, and still more by experiment, justify us in asserting, without fear of contradiction, that the states of consciousness are accompanied by objective organic processes which take place in the nerve centres and especially in the brain. These functional activities are not isolated; they are intimately interwoven with all the other vital processes of the organism; and the organism is continually influenced, in its turn, by the forces of the external world, to which it can sometimes react on its own account without the intervention of the brain, while the brain may be influenced by some of the indirect effects. So that the little group of objective phenomena, which we may associate with states of consciousness, forms a part of the mechanical processes of the universe and can not be separated from them. *It must therefore be regulated by mechanical determinism.*

This bond between the phenomena of the subjective world and those of the objective world is expressed in the well-known law of *psycho-physical parallelism*, according to which every state of consciousness corresponds to some special activity, or rather group of activities of the objective series, without which it could not exist.

Here we find ourselves confronted with the metaphysical problem of the relation between the subject and the object, between the psychic world and the physical world, between consciousness and the objective world which we are compelled to admit, exists, real and persistent, beyond the limits of our own consciousness. The interpretation of psycho-physical parallelism is intimately connected with this problem of the relation between the states of consciousness, which are subjective, and organic phenomena, which are objective.

Now are we to accept the theory of *materialistic monism*, which defines consciousness as a form of energy, subject to mechanical laws and capable of being transformed into other varieties of energy; or that of *idealistic monism*, which sees in consciousness the only reality, and suggests that the whole objective world and the other psychic personalities outside our own are nothing more than constructions of consciousness which do not correspond to any reality outside that same consciousness? Or shall we embrace that of *relative monism*, which interprets consciousness and the objective world as two aspects of one and the same reality, which however is beyond our grasp? Or shall we accept the theory of *dualism*, and recognise under these two diverse qualities two forms of essences, and admit a mysterious law which regulates the still more mysterious relations existing between them? Or, lastly, shall we fence ourselves round with an absolute *scepticism*, refusing to

see any value in experience or in reason, and identifying the true with the false?

We reject as illusory all these traditional solutions, and we deny the legitimacy of the metaphysical problem.

From what we have already said it follows that it is not necessary to insist on a *materialistic monism*. We have excluded it by demonstrating that consciousness, *per se*, is not under the control of a mechanical determinism. It is easy to say that psychic activity is a form of energy just as the others; but the fact that it possesses a subjective aspect which the others do not, creates for consciousness a special position, which perhaps is not independent of mechanical activity, but stands on a different plane.

Idealistic monism does not admit of any reality other than that of consciousness, and as consciousness is considered to be purely subjective and as our knowledge of the consciousness of others is not direct but rests upon objective evidences which reveal its existence, it follows that the idealist, if he wishes to be consistent, should believe nothing real excepting consciousness itself, and should therefore arrive at the *most rigorous "solipsism."*

If it is suggested to the idealist that consciousness has no idea of the existence of the brain to which it is bound, or of the organs and the functions with which it is associated, that the cells and fibres of which the brain is formed have no consciousness either of themselves or of the mass of which they form a part, that the cytological elements, the molecules, the atoms and subatomic units are completely apsychic and yet take part in the carrying out of conscious acts, he will reply that all this is non-existent, excepting in so far as he is able to represent it to himself, and at that moment and for that moment only. Nor is it of any use to say that the brain exists even in the unconscious cadaver, that the nerve-cells existed before Ehrenberg discovered them, that the physiology of the nervous system is the

laborious and purely scientific work of anatomists, physiologists, and pathologists; th. idealist will still reply that anatomy, physiology, physics, chemistry, and mechanics are subjective fabrications, and that the nerve elements and they who discovered them and described their marvellous intricacies, and Ehrenberg, Golgi, and Cajal, and their works, and even the persons of the argumentative opponents and the objections which they formulate, are pure creations of his consciousness, equal in value to the fantastic scenes which are developed in a dream.

All this, it is clear, is contrary to common consciousness, and has the appearance of being an audacious and arrogant paradox, which is uttered simply to impress the fool. It is however the only logical consequence of idealism, the only attitude which would justify the idealist in flattering himself that he had conquered every objection. And as a matter of fact there is no objection which is based on the presupposition of the existence of a reality outside our consciousness to which idealism cannot oppose its inveterate prejudice. The inconsistency of this doctrine cannot be demonstrated except by a *reductio ad absurdum;* and idealism must therefore be admitted before criticism of it can be attempted.

Having admitted the idealistic doctrine, we can first raise the objection that consciousness is not a chaos of disordered states, but is a regulated system subject to laws and to fixed conditions. And if by virtue of these laws and of these fixed conditions we are led spontaneously and inevitably to admit that there does exist a reality outside of and independent of consciousness, for what reason must this datum of consciousness be rejected as false and illusory? Further, if consciousness is the only reality, what signification can the terms error and illusion possess when applied to the same data of consciousness?

The idealist, however he may interpret the so-called objective world, cannot deny the experience which induces him to recognise it, or, as he expresses it, to create it. Neither can he refuse to admit that psychic processes are dependent on certain organic conditions, and that even the simplest sensation, a state of consciousness which cannot be analysed subjectively, is evolved in thousands of histological elements of different structure, constituted by many substances possessing a highly complex chemical structure, which, as a part of a living organism, must be subject to special processes of functional activity and of material change of whose complexity we have at present very little idea. If we grant that all these data of experience have no value except as purely subjective facts, and that when we speak of anatomical, physiological, physical, and chemical facts, we do not intend to indicate more than certain co-ordinated groups of representations, of states of consciousness, we shall soon find that we are simply arguing in a circle. Every element of consciousness, even the most simple and rudimentary which admits of no further resolution, is the equivalent of an immense number of distinct and ordered states of consciousness. These represent the result of a corresponding physiological process, which depends on the activity of thousands of microscopic and extremely complex elements. And the same process of reasoning may be applied to every state of consciousness, *ad infinitum*.

Experience interpreted according to the idealistic formula leads therefore to an absurdity, that is, to a denial of the same experience. And as a consequence idealism tends towards the most absolute scepticism. Subjective experience no longer gives us any absolute certainty, but rather the opposite; the true and the false have no significance; experience and reason are words void of meaning; will and action are of no importance.

A relative monism contents itself with a purely verbal

and discreetly arbitrary solution. On what grounds can it be said that the physical world and the psychic world are two aspects of the same inaccessible reality? Such a statement is based on the constant relations existing between facts of consciousness and organic facts. But who can say that instead of this unknowable reality there do not exist two, three, a thousand, innumerable realities equally unknowable to us but still equally bound to one another by constant and rigid relations, so that the physical world and consciousness are not two faces of the same object but rather the extreme links of a long chain? On the other hand relative monism is based on the fact of the relativity of knowledge. This leads as a matter of course to the relativity of all our concepts including those of quantity and number. What right then have we to limit ourselves to the concept of "*one,*" even though it be the theory of monism, and, neglecting the data of experience, to assert that it includes the *absolute reality.* Such an application is not legitimate; and if it were legitimate, we could adopt the concept of two, three, or of infinity with equal justice. And, moreover, what value can be attached to the concept of the *absolute,* if it is relative like all our concepts, if it is *relatively absolute?*

The *dualist systems* are with good reason preferred by the mystics, who are obliged to seek in them a philosophical cloak for their religions. They contain elements which are entirely gratuitous and unfounded, and also elements which are contradictory. Assuming that the mechanical laws are inapplicable to the states of consciousness, to the psychic world—which we ourselves have recognised and illustrated to a considerable extent in the foregoing pages—they assert that there is an essential difference between the physical world and the psychic world. This conclusion is no more justified than is that of relative monism. Neither the one nor the other is founded or can be founded on experience.

In any case, we must, from the logical point of view, admit the impossibility of any action and reaction between these two worlds which are so totally different the one from the other, and also the inconceivability and incomprehensibility of any bond whatsoever, in the shape of a causal relationship, between these two forms of reality. But the dualists, having a marked predilection for the psychic, do not hesitate to admit an effective, active, and even creative intervention of the psychic world in the physical world; an intervention which is incompatible with the fundamental diversity of the laws of the two worlds, which can in no way be demonstrated by experience, and which is conceivable only in a purely verbal manner.

Scepticism, although it denies the right of existence to metaphysics, is itself based on a metaphysical ambiguity. Having seen that all the traditional solutions—and they alone are possible—of the metaphysical problem have failed to explain it, the sceptic forthwith issues an accusation of ineptitude against both experience and reason. But in so doing he admits implicitly that the problem was legitimate. It is not that reason has proved itself to be insufficient to resolve the problem; it is rather that the problem, *per se,* and exactly because it is metaphysical, is really insuperable. The impossibility of formulating the square of the circle is not the fault of geometry; and the impossibility of deciding for or against monism is not due to any defect of reason or of philosophy.

Experience leads us irresistibly to admit the existence of a world outside our consciousness, the objective world; it does not succeed in explaining the laws of consciousness and not even the cohesion of the elementary states of which it is composed, without accepting the existence of a physical world, which is extraneous to our consciousness. But if that be granted, it must be admitted at the same time that it is vain to attempt to

identify in consciousness that reality which is extraneous to it. We may be justified in accepting that the picture which we have of the external world is a construction of our consciousness—and so far we are in agreement with the idealist—but, whilst he affirms gratuitously that this hypothetical construction finds no counterpart outside consciousness, the sceptic ends by asserting that the construction itself is false, that consciousness deceives us. But this is absurd. The true and the false are judged according to the limits of our experience, and only in so far as we admit the existence of an objective world. Then only is it possible to make comparisons between the supposed and the perceived, between that which is the product of intuition and that which is obtained by reasoning or through perception; then only can we recognise similarities and differences. But beyond the limits of experience, the words "true" and "false" have no significance whatever, and any attempt to consider consciousness as the only reality is equally vain.

Philosophy, extricating itself from the vicious circle of metaphysical doctrines, should aim at developing the conception of a pure *realism*. This realism, which is based on experience and refuses to acknowledge metaphysics, neither can nor should differ essentially from the *primitive realism*, which is common to man and to the higher animals, and which is the spontaneous product of the normal development of intelligence. It will be a realism which will be rendered more intelligible and more profound by a minute analysis of psychic processes; it will be rendered more perfect by a criticism based on knowledge and its mechanism, and it will be carried to greater precision in its practical conclusions by being made to depend on a greater number of experiences. But in its general lines it will be identical with primitive realism.

It may be said that the uncultured man, the child,

and the brute are ignorant of the principle of the relativity of consciousness, that they ingenuously apply the data furnished by their senses to the objective reality, and that they consider their own sensations to be really inherent qualities of the object. If by this it is meant that the peasant, the child, and the dog know nothing of phenomena and of things as they are in themselves the statement is perfectly reasonable, and it is questionable whether this is altogether a disadvantage. But if it is intended to convey the idea that they have no intuition of the laws which regulate perception and the relations existing between states of consciousness and the properties of things, then it is entirely false.

If a child says that sugar is sweet, it considers the sweetness as a property of the sugar; on the other hand, it is not ignorant that this property is not appreciated if the sugar is held in the hand or is simply looked at or smelt, but only when it is introduced into the mouth. If it says that a needle is sharp it knows perfectly well that in order that it may prick its pointed extremity must be touched by a living hand with a certain force. A peasant certainly does not believe that the world is changed because he happens to see it through a coloured glass; a bird pays no attention to its image when reflected from the surface of a pool; a dog or a hen well knows that it cannot see in the dark or with its eyes closed.

The study of psychology and the criticism of knowledge do nothing but extend this line of observation and of pre-human experiment. By analysing the mechanism of perception we enlarge our knowledge of illusions and of erroneous inductions, which are derived sometimes from sensory impressions when they are defective or hasty or restricted to one sense only (for example to touch or to vision). But it reveals nothing essentially new, nothing which is not intuitively known to all animals which possess good sensory organs and also

cerebral centres not less developed. Moreover, the doctrine of the relativity of knowledge which, as we shall see, depends on principles and facts of widely different nature and value, by no means leads to conclusions which are capable of modifying primitive realism in its general lines.

The contents of consciousness, are not chaotic or disordered in any stage of evolution. The different states of consciousness, both those which occur simultaneously and those which follow one another in sequence, are associated according to fixed laws, which are common to all organised and conscious beings.

A general glance at the facts of consciousness reveals to us various coherent groups of experiences, various separate systems, whose fundamental elements may be common to several other systems, just as points in space may be distributed in various dimensions. We recognise one vast group of experiences, without definite limits, which comprises the external world with all its contents, mobile and immobile, active and inert, and with its interminable succession of regular and irregular changes. And we also recognise another small group, our body, which is circumscribed, confined in itself, and at the same time immersed in the first. And we can always prove that our body, while it behaves just as other objects of the external world do, still has this peculiarity, that it is always present to our consciousness and is the stage of particular subjective states, *e.g.*, the affections and the will. We recognise at once that this internal activity, which we call will, determines a portion of the internal reactions of our body, and that by virtue of these we are able to modify the external world. But the action of our body on the external world is distinctly limited. As a rule the phenomena of the external world proceed independently of our will, and they, in their turn can influence our body, modify it, and favour, prevent, or impede its activities. But it

is exactly by means of these influences which it exerts on our body that we get to know it. Moreover these external forces are of various kinds, they belong to different categories, and in our bodies we find special parts, suitable organs, on which the external forces operate exclusively, imprinting themselves on them, while they are not appreciated in the least in other parts.

Our body then is an object similar to others, but on the other hand the external world becomes known to us through the impressions which it awakens in our body and which are reflected in our consciousness. This conclusion is confirmed by our observing other bodies very similar in all their parts to our own, the bodies of other men. These are to us simply external objects, but, because their behaviour in the world surrounding them is entirely analogous to our own, we are able to recognise in their reactions, which closely resemble our voluntary activities, the strongest possible evidence of a consciousness similar to our own. From one point of view, therefore, the external world is opposed to our bodies; but from another point of view our body forms a part of the objective world, and the subjective world, our mind, is placed in opposition to it and to the external world.

These are the general features of a spontaneous, primitive realism. It is not necessary however for our purpose that we should make a searching analysis of it or that we should demonstrate its genesis; modern psychology has sufficiently advanced its study. It has shown that the conditions just described are reproduced fairly closely in all animals, and that they reach a more or less advanced development which runs parallel to the progress of organisation, and always along the same lines. Spontaneous realism, therefore, is not simply the product of all the individual experiences, but also of those gained in phylogenetic evolution since the origin of life which are fixed in the hereditary organic

structures. It is a synthetic picture in which every new experience falls necessarily into its true position : a fabric to which each new experience adds a thread.

The critic will not fail to notice that according to this realism, experience coincides with consciousness, and the existence of a reality outside consciousness is a pure hypothesis. But it is the most legitimate of all hypotheses, because there is no experience which does not support it, and there are none which contradict it. Moreover it is a necessary hypothesis, and its application is as universal as the products of experience are constant. It therefore not only imposes itself on consciousness, but its negation is inconceivable.

It will be said also that it is a *metaphysical* hypothesis, because it recognises a reality outside experience. But it does not pretend to penetrate into the intrinsic nature of this reality; to accomplish this is the vain aspiration of the metaphysical hypotheses which we have examined and rejected. And it is because they pretend to go beyond the limits of experience that the metaphysical hypotheses consist to such an extent of empty words, that they fall into such gross contradictions, and are constrained to deny the value of experience itself. The hypothesis of realism is not at all metaphysical; it is a physical hypothesis, even a fundamental physical hypothesis, without which all conception of the physical world would be lost.

Then, again, it will be said that it is an hypothesis *sui generis,* which cannot be demonstrated because its object stands outside of experience. But beneath this objection there lies hidden an ambiguity regarding the value of hypotheses and the means by which they are substantiated. The facts which are employed to substantiate an hypothesis never differ in nature from those on which the hypothesis was primarily based. An hypothesis is founded on the data of experience, that is, on data which are derived through the senses; *it*

recognises that there is an order, a law, running through the data, and supposes that this order and this law must apply to all similar cases, including those as yet unknown. When the hypothesis is found to be exact, the group of data on which it was first based becomes enlarged, and the conviction that there is a law regulating phenomena and that there is an objective connecting link independent of our consciousness, is strengthened.

If the data which we derive through our senses remained isolated and presented no idea of order, it would be impossible for us to form a representation of any objective reality. Idealism would then be the only natural and possible aspect of the real; but all experience, every hypothesis and all substantiation of an hypothesis would be equally impossible. Life would be an incoherent dream, and nothing more; and there would be nothing real outside this dream. But our experiences, which are always based on sensory data, are arranged regularly as they are formed; and it is entirely due to this order amongst them that it is possible to make any conjectures, any hypotheses, and to verify them. The rigidity of this order, although perhaps not always absolute, stands in strong contrast to the fluctuating variability of our associations and representations, among which so many more combinations are possible. On the other hand, experience demonstrates that our representations, our will, our actions cannot change this order; they can only proceed according to its laws. From this arises the conviction that the law governing the phenomena is extraneous to us, is outside of us. But because our sense of personality is associated with our body, and our body occupies an extremely minute portion of space; and because after death it undergoes disintegrative changes which are capable of reducing it to scattered objective elements to which we can no longer attach the representation of our personality, the conclusion is forced upon us that it is possible for us

to disappear whilst the relations existing between things in general remain unchanged. But we cannot conceive of the annihilation of space nor can we imagine the slightest lacuna or discontinuity in it. Further, the course of time cannot be accelerated, retarded, or inverted. It is not the current of thought which creates or guides events, but the current of events which is reflected in our consciousness. That which we know would exist even if we did not know it; in fact, objective reality is extraneous to our consciousness.

When we admit the existence of an objective reality, of a permanent physical world outside ourselves, we really recognise nothing more than the fact that there are certain definite relations existing between the data of experience. These are the laws of nature which consciousness must accept as they are, and which it can in no way modify. Every experience contributes towards the establishing of this general principle, every substantiation of a particular hypothesis is at the same time a confirmation of it. It follows, therefore, that the realistic hypothesis is not an hypothesis different in kind from the other particular hypotheses which all contain a fragment of realism, but it is a general hypothesis which embraces and incorporates all the others in itself. If it is maintained that it is impossible to prove it, the reply may be made that the other particular hypotheses are even less capable of demonstration, and any datum of experience whatever becomes an idle fancy, void of sense. But if experience is not void of sense then we must conclude that the realistic hypothesis is demonstrable, and that it receives a continuous confirmation from experience, because there is no experience which does not strengthen its value.

No metaphysical doctrine possesses the power to alter our conception of realism; and moreover we all conduct ourselves in our relations with the external world, with our bodies, and with other organisms according to the

unalterable data of atavistic experience, and scientific culture never tends to deny in practice that conception of objective reality which the philosopher possesses in common with the ignorant, with the savage, with the dog and the frog.

The object of science is to render our analysis more searching by artificially improving our sensory organs, to enlarge our experience, to arrange it methodically, and to preserve it with the aid of spoken and written speech; but it adds no new property to our senses or to our brain. It may render our idea of realism more clear, but it cannot modify it in its fundamental principles.

If now we analyse the physical world and the mechanism of our sensory organs in the light of determinism we shall arrive at the doctrine of specific physiological activity. The sensory terminations, being differentiated anatomically in their intimate structure, in their relations to the exterior from the point of view of position, and in their connections with special nervous centres, have become capable of appreciating, each on its own account, special forms of physical energy, and of responding to them while they remain inert and insensitive to other forms of energy. A correspondence is thus established between the form of sensibility and the form of energy, and the symbolic value of our representation of the external world becomes manifest. Sensations correspond only to stimuli; perceptions and representations of external things are simply symbolic interpretations, which change with each variation of the conditions of experience. The most general ideas of space and time, of matter and force, are the highest symbols, and it is through them that our experience is reduced to a definite system. Moreover they undergo an evolution *pari passu* with the widening of our experience. But the relative value which knowledge acquires by this means, although it implies the possibility of, or even the necessity for, a difference of

content in the consciousness of different individuals, in no way modifies our idea of an objective reality which is unique and independent of the consciousness of anyone. Unless this were so it would have no meaning; a relation cannot be established without two terms, and such relation changes if one of the terms be altered.

The relativity of knowledge is presented to us under another aspect when we observe the affective character of the sensations, which varies in different organisms although the objective stimulus is the same. This side of consciousness, as we shall see later, does not reflect the objective relations external to the organism, but rather a different but still objective order of relations, which exists between the external actions and the organism, and which is judged from the point of view of biological utility. Under this aspect the relativity of knowledge in no way weakens the theory of realism.

The objective, anatomical, physiological, and psychological study of organisms similar to our own, or of those which are placed below ours and which possess a series of characters of a lower order though still preserving the same fundamental lines of somatic and psychic development, has elucidated for us the mechanism of nervous processes. It has demonstrated to us that the peripheral organs of sense form an apparatus for reception and analysis, that the nerves act as conductors, and that conscious synthesis takes place in the central nervous organs. States of consciousness are not associated directly with the stimulus which acts on the peripheral organ, but with an organic process occurring in the nerve centres, and a whole series of intermediate steps is inserted between the two. The process of perception, in its different phases, may therefore undergo various accidental disturbances, and in this way phenomena of illusion and hallucination may be developed in which the states of consciousness do not

at all correspond with the external reality. But our conclusions as to the value of knowledge must not be modified by facts such as these. For example, a bad taste may be recognised in a given specimen of water. An ignorant man without doubt will attribute this taste to the presence of some disgusting substance in the water. But other possibilities will occur to one who is acquainted with physiology and pathology. Among these we may mention the influence of a morbid condition of the gustatory mucous membrane, of the elimination of a drug by means of the saliva, of an irritation of the nerve paths of peripheral or central conduction, of an irritation of the centres, or the suggestive influence of a preconceived idea regarding the quality of the water. Moreover, these various hypotheses can be examined by an accurate analysis, and those which are false can be excluded. But the judgment of the ignorant man does not differ substantially in its mechanism from that of the cultured man, but only through the insufficiency of the data on which it is based.

Then again, by studying sentient organisms objectively we may see the principle of the relativity of knowledge under still another aspect. The organisms differ amongst themselves, and these differences are determined in relation to the special exigences of their life, to the nature and extent of their surroundings, to their organic needs. The structure of the nervous organs, peripheral and central, also varies. It follows, therefore, that the states of consciousness coresponding to the different nervous phenomena must also vary. The external world will wear different aspects for all the various organisms, and their appreciation of their relationship to it will also be different. But, no matter how dissimilar they may be, we cannot exclude the possibility that these experiences are all true, and they all lead to the acceptance of an objective world, which

is unique and independent of consciousness, and persists beyond it.

If the nervous mechanisms, peripheral and central, were perfect and unchangeable, if the actions of the external world on the organism could furnish complete data regarding the phenomena of the universe, then the relations between the states of consciousness, the relations which lead us to admit the existence of an objective world governed by stable laws of its own, that is, laws independent of us, would appear to us to be perfectly clear and immutable. And if the various organisms were absolutely identical, all the experiences would correspond exactly. But such a condition of things does not exist. The organisms are imperfect, they represent the product of an evolution which is still incomplete. Within the limits of the normal they exhibit such functional oscillations that they can scarcely be recognised as the same, and they all differ from one another to a greater or less extent. On the other hand the stimuli received by the sensory organs represent only a small proportion of the external events, and the sensations therefore can only symbolise these events in an extremely fragmentary manner. It is not to be wondered at then if the recognition of objective relationships, under the form of definite relations between our subjective states, takes place slowly during periods in which instead of a *uniform and constant relationship*, we have the *most variable or even contradictory relations* presented to our consciousness.

From this it follows that *consciousness,* by which is understood the complex of subjective states, always manifests itself to us as an *immediate* result and has the characters of *absolute certainty.* On the other hand *knowledge,* by which term we signify the recognition of the relations between the states of consciousness which correspond symbolically with objective relations between external phenomena, always presents some

signs of *uncertainty*. From the purely subjective point of view we cannot distinguish the false from the true; even a hallucination, as an internal representation, is true. The discrimination of the true from the false is always referred to the correspondence between the subjective and the objective phenomena. This distinction is rendered possible only by the widening and the co-ordination of experience, and as experience is always limited, there is a certain amount of doubt attached to every objective truth which is brought before us. In fact every particular cognition is an hypothesis, which with an increase of experience can acquire a greater degree of probability, but which can never attain to absolute certainty.

The synthetic results of experience are established only by the process of abstraction, which eliminates the differences and special contrasts; and these results being relieved from every element of contradiction acquire the character of certainty. Moreover all individual experiences infallibly coincide in showing us that there does exist a bond between the sensory impressions which is independent of our personality. The physical hypothesis, therefore, that an objective world does exist, since it has never been contradicted, must necessarily present itself to our consciousness with all the characters of certainty, and no process of reasoning will ever succeed in displacing it.

Turning again to the point from which we started, viz., to the law of psycho-physical parallelism, we must look upon it as a simple result of experience and not as a principle which necessarily implies our adhesion to metaphysical doctrines. It is experience, it is the scientific analysis of the organic processes which demonstrates to us the indissoluble connection between states of consciousness and groups of special organic conditions. And this holds good for normal as well

as pathological phenomena. Taking all things into consideration, the pathological phenomena of the mind differ from the normal only in this, that the organic processes corresponding to them are not the pure result of the co-ordination of the internal and external forces acting on the organism along the usual paths, but owe their singularity to the intervention of unusual and disturbing influences, and to their being carried out in altered or mutilated tissues.

If then we have recognised that mechanical determinism is inapplicable to subjective states, we have, as an alternative, found that the nervous processes, both normal and pathological, have, in so far as they are objective, that continuity which is wanting in the case of the states of consciousness. They may therefore be subjected to measurement, at least theoretically. They constitute a series of objective terms, not all of which correspond to subjective states, but which are comparable, as regards their determinism, to the mechanical phenomena of the external world. Consequently the determinism of psychic phenomena, regarded in its strictly scientific sense, may become known indirectly through that of the mechanical, objective, and physiological phenemona which take place in the body and especially in the brain.

In dealing with this subject so far, it has been suggested that although the production of states of consciousness cannot be explained according to a rigorous determinism similar to that which is found to be active in the case of objective phenomena, still it is governed by certain laws of its own. We are, however, very far from knowing all the organic processes which accompany the psychic phenomena, nor are we able in all cases to interpret psychological laws according to an objective determinism. It will, however, be of some advantage to enquire what is the value of the laws

which we have gained from subjective observation even though they be purely empirical. Some idea of the value of these laws has already been given while we were examining the question of the value of knowledge. We shall understand them more clearly when we have considered the subject of psychology from the biological point of view, that is as a manifestation of life.

Psychic phenomena, like all the phenomena of life, are acts of *adaptation.* To live is to adapt oneself to external circumstances, making use of those which are beneficial to the organism, and avoiding or overcoming those which are injurious. In order that this adaptation may take place it is necessary that the organism shall receive information from the external world and that the external phenomena shall give rise to processes in the organism between which and the external phenomena there shall exist some constant and regular qualitative and quantitative relations. It is necessary also that the organism shall be cognisant of its own condition.

To Spencer belongs the merit of having demonstrated *the law of correspondence* as a fundamental principle of psychic life. According to this law the activities of the external world are represented by a whole series of psychic states. Sensations are in part the symbol of the immediate influences which the environment exercises on the organism, and in part also the symbol of the active internal processes which the organism can use in opposition to the environment. The perceptions provide a symbolic and indirect reconstruction of the objects of the external world, and the conformation of our own body is reconstructed by the same mechanism. But in any case our sensations and perceptions give us only the present reality. When however we deal with representations, with records, with ideas, we pass from the real to the possible. These are symbols of that which is not present at the time, of that which is not

visible or tangible in space, of that which does not come under the notice of the senses but which still may exist, of that which has not yet happened but which may happen sooner or later. Association takes place between ideas just as it does between external phenomena. The laws of reason are a synthetic symbol of the laws which govern the objective reality, *i.e.*, of natural laws.

Association, therefore, even if it has no value as a law which determines psychic phenomena, may, by means of this biological conception of these phenomena, be looked upon as an echo of the laws of the external world, as a reflection of objective determinism. Every phenomenon of life is naturally an imperfect adaptation, and psychic processes also share this inevitable imperfection. And as the type of organism in the animal kingdom has become more complex, so this correspondence has developed in a series of forms which have gradually become more perfect, but are still only approximate. Even in man every acquisition of intelligence and of knowledge consists simply in an amplification and a greater precision of correspondence. Science itself is the most elevated production of this adaptation. Its aim is to acquire the maximum of knowledge and of prescience both from the point of view of extent and exactness.

But besides the imperfections which are necessarily connected with all the functions of organs the law of correspondence exhibits an intrinsic defect which is unavoidable and to a certain extent useful, and confirms still more strongly the biological significance of psychic phenomena. According to the law of mechanical determinism the real in the objective world must always be identical with the possible; there is only one possibility, reality; and reality is what it is and what it must be because of the action of the determinants which have preceded it. An absolute correspondence therefore

could not be otherwise than unique; the association of ideas would require to be as rigid and inevitable as the succession of the external events.

Theoretically everything could be foreseen if we could know all the determinants. But the determinants of a phenomenon are infinite. They have not all the same value; some of them act more directly and have a greater dynamic potentiality, and they therefore become the most important factors. But this does not exclude the possibility that some determinants, far removed in time and space, may exercise an influence capable of rendering fallacious any prediction. Prediction, therefore, can never have more than an approximate value, and those predictions which appear to be most securely founded are nothing more than hypotheses, endowed with the greatest probability, it may be, but still hypotheses. As a consequence, association must be plastic and manifold in order to carry out its biological function. To the lacunæ in our knowledge of the determinants there must correspond a looseness in the associative chain, a certain indefinite character in the representation of causal sequence. *From the biological point of view the possible must be multiple.* Truth is as constant and inflexible as reality, but thought, no matter how logical, is many-sided and as uncertain as probability.

A certain rigidity and a more marked tendency towards unity is seen in abstraction, because abstract ideas, and with them abstract judgments, do not correspond to particular facts, but are formed by the synthesis of the most essential and constant elements, those which are most important, and they gradually eliminate the variable elements which give rise to error. We see the maximum degree of rigidity and of unity in mathematics, but it is common to all mental synthesis to a greater or less extent. And it is for this reason that a theory or even an hypothesis frequently has a greater force of reality than a direct observation.

But the phenomena of intelligence, of knowledge, those to which the theory of association and the Spencerian law of correspondence are applied, do not constitute the sum total of psychic phenomena. In fact they form only the passive portion of an act considered as a biological phenomenon, that is, a phenomenon whose object it is to produce an adaptation to some external condition. *Ideas* by themselves do not necessarily give rise to any active reaction. When they do so it is through the addition of other elements to the psychic process of ideation, that is, by the addition of those states of consciousness which are known to us as the *sentiments* or the *affections.* And in the most complicated psychic processes, in which the reaction is preceded by the representation of the act which is to be carried out, there is added a sense of some special internal activity which we term *will;* the sentiments and the will are not taken into account in the law of correspondence as formulated above and as we have so far considered it.

The phenomena of sentiment are governed by a particular law of correspondence of their own. They do not correspond directly to the external world as dc the phenomena of knowledge, but rather to the positive or negative value, judged from the biological point of view, which the external activities or even the changes occurring in the body assume, that is, in so far as they are helpful or prejudicial to the preservation of the organism. They are, therefore, distributed between the two poles of pleasure and pain. It is for this reason that while the phenomena of knowledge tend towards a relative uniformity in all organisms, the affections vary with the variation of the organic species, with the variation of the individuals of the same species, and with the variation of the momentary conditions in the same individual. The external reality is constant and therefore as the correspondence becomes more perfect the

symbolic reproduction must tend to become more exact and invariable. The needs of organisms, and the useful or injurious effects which external influences can exercise on them vary as much as do the organisms themselves; and as a consequence the affective states must present a corresponding diversity. And since the reactions of the organism must be guided and controlled not only by the objective knowledge of the external world, but also by the importance and utility of their effects for the individual whether he executes them himself or is the subject of them, and for the species of which he is the representative, it follows naturally that the sentiments are the more immediate guides to action and are therefore the most important factors in the determinism of the act.

The will symbolises our control over action and implies the organic possibility of opportune execution whether it be done immediately or whether circumstances necessitate a delay in its accomplishment. The act of volition depends on the realisation of a harmony between an efficient reaction, a sense of what is to be done, and also of what is beneficial for the organism; it includes therefore all the aspects of psychic activity.

With the aid of this biological interpretation we have been able to discover the significance of the laws which empirical observation has shown to exist in psychology. The same interpretation enables us to understand the reason of the psychological differences in the various animals and allows us to offer some explanation of the genesis of certain psychic tendencies and of the special particularities which are exhibited by the organ in which they arise, viz., the brain.

So far we have considered the general problems of determinism in relation to normal psychic phenomena. In order to complete our enquiry we must now see to what results these conceptions will lead us if we apply

them to pathological phenomena; in other words we must determine what effects are produced on the structure and functions of the brain and on the biological needs of the organism by morbid conditions.

We have already seen that a perfect adaptation of the organism to its surroundings is never realised. Putting aside the cases of want of adaptation which depend on immaturity of development or on decay, we may say that no individual ever will develop to perfection all the attributes which are characteristic of its zoological species. The mechanism of heredity, no matter how marvellously delicate and minute it may be, and in fact just because of this delicacy and minuteness, must always be sensible to the thousand causes of arrest, of deviation, and of perversion, which may exercise their injurious influence during the course of embryonal or post-embryonal development. Every individual variety, one may even say every individual, is in itself an exception to the law of heredity, though to a partial and scarcely appreciable extent. Variations which depend on pathological causes are always markedly divergent from the normal; and the greater the duration of action or the importance of the cause of the morbid condition the more nearly do they approach to monstrosity.

In some cases the departures from the laws of heredity are beneficial to the organism, and offer to natural selection a material which may be made use of for the progress of the species. And it may be that a differentiation of new species is partially due to these accidental and progressive variations which are added to and perpetuated in the hereditary patrimony. But with the higher development of the organism the ordinary mechanism of heredity becomes more complicated and more fixed; the opportunities for useful variations to arise are limited, whether they be those of adaptation or simply accidental, and the difficulties to be overcome

are increased; but this mechanism is always exposed to disturbing influences. The nervous system especially is frequently liable to suffer from such injurious conditions. The long duration of development, the special sensitiveness which some systems possess at certain phases of development, increase the opportunities for some disturbance of the law of heredity; and the more robust units of the organism do not always succeed in limiting its extent. There may thus be produced systemic or partial arrest of development, and, where the causes have been active at an early period or have been of greater intensity, there may be a general arrest. In the slighter cases the arrest of development may lead to such a uniform deficiency that the application of the term variety or even of inferior species may appear to be justifiable; but such a use of these terms is not to be commended.

There is no doubt that these cases of general but slight arrest of psychic development, in which, from the point of view of psychiatry, merely an anomaly can be recognised, are relatively rare, and it has been a grave mistake, towards which there is still an inveterate tendency, to wish to extend this conception to all or almost all the categories of insanity. But in these cases we see that the disturbance of the psychic mechanism by no means admits of a psychogenetic interpretation. Its cause must be looked for along an indirect path, that is, in a lesion which affects the nervous system only secondarily.

Interrelations of this sort may be seen much more clearly in the great majority of psychopathies, in the mental diseases properly so called. In these we have to deal with brains which for a longer or shorter period have shown themselves to be normal, or, at least from the functional side, have not revealed any deficiency. Various causes, of external origin and often coarse in character, produce lesions and functional disturbances,

which on the psychological side, manifest themselves in insanity. And although morbid causes, which act on the brain, destroying it, paralysing it or stimulating it, do not create any new function, still states of consciousness can be produced by them in the psychological field, which are unusual in their intensity and in their grouping; the elements of which these consist, however, are always produced by the partial, irregular, or disordered activity of pre-existing organs and functions. This does not preclude the possibility that the psychological manifestations of insanity may at times assume such a strange and peculiar aspect as to defy any comparison with normal psychic processes.

Nor need this occasion any surprise. The morbid processes of the brain which determine the disease, frequently have no definite connection with any particular anatomical mechanism. There are, it is true, certain slow intoxications which exercise a selective and systemic action on special portions; but more frequently the lesions are not selective, and they advance for reasons which have nothing to do with either psychic or anatomical mechanisms. A hæmorrhage follows the mechanical law of least resistance in producing a destruction of nerve elements; an embolic softening corresponds to the law of the distribution of the vessels; and an inflammatory process spreads by contiguity from the point primarily affected, while at the same time it may exhibit certain preferences. The chemical actions themselves, which usually produce selective lesions, do not follow any physiological law but depend on accidental affinities peculiar to the individual and not on any biological determining factor. And even when the anatomical lesion affects a special system of cells or fibres exclusively, it is not always possible to discover an analogous systemic disturbance in the psychic condition of the patient. The relations existing between the physiological mechanism of special anato-

mical systems and the corresponding order of psychic functions are still far from being understood, even in the simplest cases. This may be due to the unforeseen objective complexity of the anatomo-physiological mechanisms or it may be that the psychic lesions are presented to us in a way which is quite unusual.

We are accustomed to individualise the psychic processes and to consider them from one of their aspects only, viz., as biological acts of adaptation. But they really pass through many phases between the sensory reception and the motor reaction, whether voluntary or otherwise. Many diverse functions take part in this cycle of psychic phases, but we are unable to represent them to ourselves isolated from one another. And there is no less difficulty in picturing the results of a functional deficiency which become evident if a single step is omitted. It is true that introspective and physiological and experimental psychology aim at analysing these general functions and at recognising their isolated variations. But such attempts merely touch the problems whose complexity is always greater than is surmised. And therefore when pathology gives rise to conditions which we cannot produce experimentally the result always comes to us as a surprise. A proof of this may be seen in the pathology of language which has entirely revolutionised our conception of the physiological psychology of this function.

Therefore, even when the psychic disturbances are developed in organs which although not entirely sound are still capable of function and according to normal or approximately normal laws, there is no great advantage to be gained for psychiatry by bringing it into line with the biological law, that is, if we are to assume that the aim of psychiatry is to discover the objective determinism of the disturbances under consideration. Psychic acts, conduct, are changed not because this or that series of adaptations is altered, but because some elementary

functions are modified which by themselves do not constitute any complete adaptation and may in fact enter into the mechanism of all. The defect of adaptation arises as a secondary effect of the alteration of these elementary functions. A psychological enquiry into psychiatry should rather tend to ground itself on a physiological and anatomical psychology, which seeks to isolate by analysis these elementary functions and to place them in some relation with anatomical systems. In this way only can the psychological data be made to coincide with those of the psychological physiology and pathology of the brain, and thus lead to the diagnosis of the seat and of the nature of the alteration and at length enable us to obtain some idea of the pathological process.

If, in the present state of practical psychiatry, we attempt to apply these theoretical considerations, we shall meet with numerous difficulties. Some depend on the fact that the insane do not lend themselves to delicate and methodical psychological analysis; others, and these are the more common, are due to our defective knowledge of the subject of psychology itself, and to the scarcity of connecting links between it and the anatomy, physiology, and the general pathology of the nervous system.

It is useless to attempt to dissemble. Psychological examination of the mentally afflicted, on which a large number of psychiatric diagnoses are almost exclusively based, is still carried out in an extremely primitive manner and by the same procedure which everyone employs spontaneously whenever it is necessary to investigate the psychic character of any individual whatsoever; but in the case of the insane we are from the first confronted with special difficulties and uncertainties.

The facts on which the diagnosis depends are derived

from retrospective information, from observation, and from interrogation.

The history of the patient is of the greatest importance and often furnishes valuable data for the diagnosis, but too frequently it is exaggerated from a love of romancing or confused by false interpretations or prejudices or through ignorance or from some ulterior motives, and it requires much reflection to make a judicious selection.

Very important evidence as to the mental state of a patient is derived from his spontaneous actions and motor activities in his natural surroundings or in an asylum, or under the artificial stimulation of the physician. The gestures and the acts of mimicry reveal the state of the affections; the voluntary behaviour betrays impulses, dislikes, perversions of the will and of the instincts, and sometimes the inability to react to the surroundings in any way whatever. Conversations and letters are naturally of great value because of the number of particulars which they can furnish regarding the past life, the present state, and every variety of psychic activity of the patient.

Interrogation confirms and renders more precise the data derived from observation; it furnishes information regarding all the subjective states of the patient, the general state of his consciousness, his orientation as to time, places, and persons, the substance and order of his ideas, his memory, the consciousness of disease, the affections, the presence of delirium and hallucinations, the capacity for attention and the power of comprehension, the instability of his beliefs and conduct. In all these examinations many points of obscurity and causes of error are encountered: the diffidence of the patient, the tendency to exaggerate, to invent, to simulate, or to dissimulate. Even if in certain cases a brief examination is sufficient to give clear and precise data, in other cases a prolonged study, with perhaps a

modicum of dissimulation, is necessary to enable us to arrive at satisfactory and reliable conclusions.

A psychological examination, carried out in this way, can without doubt provide real objective facts which may be tabulated; but it is not always possible to exclude that the most positive data have not been obscured by purely subjective impressions and by dogmatic preconceptions. On this account some observers have wished to introduce into psychiatry the employment of a method which has given some results with regard to certain points of normal psychology and of the psychology of defective children: I refer to the so-called mental *tests*. The intention was without doubt excellent; it was hoped that by employing the same methods of examination the results would be comparable and that they might be submitted to statistical examination. But practice has not confirmed this view.

Human mental activity is too complex for it to be possible to include all its elements in one formula however comprehensive it may be. It is true that certain fundamental principles are common to all psychic processes and there do exist some really natural tests for the simplest psychic processes. Who does not know that by simply asking a patient his name, his age, his occupation, his civil state, and other questions of this sort, it is possible sometimes to get replies which at once point to the correct diagnosis? But this is because these natural tests have always been in common use; they suggest themselves to us spontaneously. It is, however, in connection with the more complicated processes, with the personal factors of the psychic edifice that the most striking difficulties are met with. Now in this field of enquiry the selection of tests is absolutely arbitrary, and it would be difficult to persuade all observers to adopt a uniform method. The number of tests would be excessive, so that in every psychological examination an enormous number of useless interroga-

tions would be made. This besides depriving them of any serious importance would weary the examiner and the patient, who would in fact demonstrate his sanity by rebelling. On the other hand, if for this reason one item were neglected, the methodical character of the examination would at once disappear. The more numerous the tests which it might be thought desirable to apply the less importance could be attached to each and the more problematical would be the value of a mistaken or deficient reply. Among the experimenters who employ this method, there are some who in a really complete examination would expect to submit their subjects to more than a hundred tests; and this number would be increased because most of the tests are not to be relied on unless they have been repeated several times and at certain necessary intervals, either days or weeks. The differences of the results between the various subjects must become so numerous and so confusing that it must be impossible to draw any conclusions whatsoever from them.

Very different, both in the means employed and in the objects to be attained, are the methods of psychological examination which are employed by Kraepelin and his school in the study of normal and pathological psychology. The several psychic functions are examined by comparatively simple methods. The capacity to receive external impressions, active and voluntary attention, the memory both in connection with the conservation of old and the power to fix new records, the promptness, the richness, the contents of the associations which are provoked in the simplest way possible by words heard or by objects seen, the quickness with which voluntary impulses are determined, the attitude towards protracted labour, et cetera, are the subjects of special study. By this means an insight is obtained into the state of these functions in the patient examined independently of their particular contents, and any subse-

quent disturbance of them will render intelligible many peculiarities of the ideative faculties, of the voluntary decisions and of the conduct of the patients, and will illumine their individual history.

Naturally these methods lead to fruitful results much more easily in the sane than in the insane. In dealing with the latter it is often necessary to simplify the methods to such a degree that the co-operation of the patient is really reduced to a minimum. We must therefore admit that the final results of these enquiries by the simplified methods do nothing more than confirm what might be legitimately inferred from empirical observation. But this does not invalidate the importance of the method and should not lead to the neglect of its employment. There is no doubt that by its use the conclusions arrived at are clearer and more sound, and a comparison of the pathological data with the normal is easier and more legitimate. Moreover, this sort of experiment habituates one to examine the pathological phenomena more analytically than does the mere acquisition of an anecdotal history of the habits and conduct of the patient.

Kraepelin, with great judgment, adds to these researches the systematic study of the effects of nerve poisons on normal individuals. Apart from the fact that many mental diseases are the result of toxic action, these experiments are extremely instructive because nerve poisons have a more or less marked elective action on special systems and functions. By exaggerating or weakening separate nervous activities, slight intoxications experimentally produced make it possible for an analytical study of the human mind to be carried out, and thus add a contribution of facts to psychology which no observation of the normal could possibly furnish. The reaction to certain poisons is often modified in mental diseases, and sometimes to such an extent and in such a characteristic manner that Kraepelin sees

reason to hope that a great number of useful results may be obtained from the study of the action of poisons in diseases of the mind.

The field which at present lends itself best to methodical and exact research is that of the *aphasias.* Here the examination is immensely facilitated by the fact that the patients rarely exhibit any grave intellectual or affective disturbances or defects of volition outside the sphere of language which would render them unwilling to submit to examination or which would introduce any special difficulty. The subject has been so much studied from the anatomo-pathological point of view that our conceptions of the mechanism of language are now much more exact and comprehensive, and there is therefore an urgent necessity for a more thorough analysis in the field of psychological examination. It may also be mentioned that as the research has become more refined the insufficiency of the old simple schemes has constantly become more evident. The various centres connected with language have been found to be dependent one on the other in ways hitherto unrecognised, and it is now seen that the function is more complex than has generally been imagined. In fact it has become so complex that some have wished to establish it as a type of all the psychic functions. Wernicke and his school, for instance, have attempted to draw up a scheme for the whole of psychiatry which is based on the general lines of the function of language. By so doing they are without doubt carrying matters to an extreme, but some useful results have followed.

Gross macroscopic lesions of the brain have hitherto been almost entirely neglected from the point of view of their intimate psychic symptoms. While the physicians fix their attention on the anatomical lesion and take little account of psychic symptoms, regarding them rather as accessory facts, the alienists, on the other hand, attach little importance to these cases,

and almost consider them as being outside their sphere of interest altogether. But as a matter of fact the most obvious lesions of the brain are often unaccompanied by any changes of the psychic personality likely to command the attention of the casual observer. It is only since the study of the aphasias has been undertaken that attention has been drawn to this field of enquiry; and it is a field which yields most abundant and important results. In connection with the syndromes of aphasia, which affect only the various categories of speech images—auditory, visual, and motor—there now appear various forms of asymboly, of apraxia and parapraxia, which consist in the isolated loss of representations, memories, or ideas of things and of actions. In the senile psychoses which are due to coarse alterations of the vessels, whether accompanied by focal lesions, by softenings, by limited atrophy, or not, an accurate examination conducted methodically often reveals interesting phenomena of asymboly and of apraxia which at one time passed for a simple mental confusion.

It is too often said that coarse focal lesions of the brain can pass unobserved because of the absence of symptoms in spite of the fact that all the data of anatomy and of physiology constantly tend to restrict the doctrine of vicarious functions. It is rarely admitted now that when a nervous organ, for example a portion of the cerebral cortex, is destroyed, some other parts can take its place and carry out its functions. Every structure in the nervous system has a specific function, and if a portion is destroyed, it can not be replaced anatomically, and, from the point of view of function, the compensations which are provided indirectly are always far from being complete. If in such cases no defect is recognised, it must undoubtedly be due to insufficient methods, to which may be added perhaps a want of patience on the part of the observer.

Another field which lends itself to research in connection with psycho-pathology is that of the emotions. Now the doctrine of Lange and James, according to which visceral sensations, produced by the direct motor action of the brain on the viscera, are the principle factor in exciting the emotions, gains ground daily and is constantly being confirmed by physiological and psychological investigations and also by the data of pathology. The visceral reactions are therefore an index of the affective states, an index which is all the more valuable because it cannot be influenced by the will. In fact the observations which are now made on the nature of the pulse and on the variations of the blood pressure in emotional states are providing results which allow useful comparisons to be made with the pathological conditions.

Certainly it is not easy at present to establish a close relationship between the phenomena observed in a psychic examination of a patient and the anatomical and physiological examination of the psychic organs. The distance between them is vast and it seems probable that the study of anatomy and physiology will do most to approximate them because the technique of these two branches of enquiry is so much more perfect. But this does not relieve us from the obligation of attempting to do something from the other direction, and the task will gradually become more easy as further observations in the objective field provide us with clearer conceptions of the psychic mechanism and suggest new methods of analysis.

III. Anatomical Problems

Since consciousness depends upon organic processes in the brain, the sum-total of the changes induced by these processes must form an objective symbol of consciousness. The structure of the brain statically symbolises in a certain fashion—just as a machine symbolises an industry—all that may occur in consciousness, the potentiality of the particular psyche, and therefore not only symbolises the animal's body itself but also whatever is accessible in the external world to the animal and the relationships of action and reaction which theoretically link together the environment and the organism. If our anatomical knowledge was complete we could deduce from the structure of a brain not only the size, the form and the structure of the animal to which it belonged, but also the environment in which the animal lived, its habits, and the activity it was capable of exhibiting.

There is no doubt that anatomy, aided by what we know of physiology at the present time, defective and disconnected though it may be, can answer at least in a general fashion many problems of this nature. Conversely, where physiological and psychological attitudes are known, the anatomist can account for certain singularities which some species of animals show in their cerebral cortex. Following precisely this parallelism of cerebral anatomy with physiology and with the psychology of certain animals, Gall succeeded in establishing the fact that the brain cortex is the particular organ of psychic activity.

Since then this principle has remained unchallenged

and even received constant confirmation. Still this does not mean that psychic activity depends exclusively on the cortical functions: these are also influenced by the functions of all the organs of the body; and between the cerebral cortex and these organs there is a constant coming and going of reciprocal dynamic influences. But the cortex is the organ in which all parts of the body are represented, in which the projection of all external action occurs; it alone realises the anatomical symbolism which we mentioned above. The underlying nerve strands serve as paths for the exchange of dynamic action; all the subcortical centres discharge functions doubtless of the greatest importance, which are presumably physiologically necessary for cortical function; but as specific functions they carry out particular co-ordinations, more or less complicated reflex acts, which in themselves have no psychic characters. Therefore if every particular of structure of the nervous system represents a problem for the physiologist, the psychologist must maintain uppermost in his mind the functions of the cerebral cortex.

The *cerebral cortex*, at first regarded as a uniform structure anatomically and functionally, has been subjected from 1870 onwards to frequently repeated experimental examinations by the methods of electrical stimulation and operative destruction. Stimulation, by the variation of its effect according to the point of application, reveals the primary origin or at least one station of the active function which the experiment happens to be provoking; destruction, after the general disturbance induced by the operation has passed off, discloses the seat of the lost function. From these experiments arose the doctrine of cortical localisation according to which the cortex is divided into sufficiently distinct though somewhat overlapping regions related to the various functions of sensation and motion. The

latter, by coming into greater evidence objectively, have been defined with more precision; of the sensations, that of sight has been more precisely localised than any other. Nevertheless there still remained numerous uncertainties, and certain fields of the cortex—for example, the frontal lobes—continued dumb to experimental investigation.

During this period anatomy lagged some distance behind physiological experiment, and though it furnished some confirmation to the more precise views of localisation, it achieved little on its own account. But anatomical research was destined to surpass experiment very quickly. Granted the complexity of relationships which every portion of the cortex assumes with others and with the underlying organs; given the structural complexity of the cortex itself, constituted as it is by various strata of very numerous and profoundly different cellular elements, it was not possible by the coarse means of experiment to obtain results beyond a certain limit. On the contrary, anatomical analysis, founded on microscopical data, can legitimately determine the perfect reconstruction of the whole nervous organ.

Thus researches carried out in the last ten years, above all by Ramon y Cajal, Nissl, Brodmann and Vogt, have demonstrated that the cortex, far from being uniform, shows the most distinct differences in all its parts, either in the number of strata, or in the quality and number of the cellular elements of which these strata are formed. Not only so, but the boundary limit between one cortical type and another is very often abrupt and distinct; so that a methodical study of sections microscopically thin but extended over the whole extent of the brain and arranged serially, allows of the sub-division of the cortical area into zones sufficiently definite, some of which correspond—under certain limitations—with the areas already established by experiment. As yet this study is only in its infancy;

it will be neccessary now to extend it systematically to many types of animal species and to apply it on a large scale to man. The researches already accomplished furnish us with the evidence of these differences and present some brilliant proofs of them; in some species which have been thoroughly studied a minute description of the details of the cortex, with very complex but quite clear and precise subdivisions, has already been made; and further, in comparing the brains of very dissimilar human races, some difference in position and form of the single areas has been noted. There is no doubt that this study although demanding self-denial, patience, and exceptional technical and financial resources, will be carried in not many years to a satisfactory state. The physiological import of zones so isolated in every brain will be inferred not only from physiological experiment, and from collated anatomical and psychological observation, but also from the anatomical connections which every area assumes with definite nerve paths.

Flechsig, pursuing an entirely novel and special method, has discovered, in the varying data of embryological development, another means of classifying and sub-dividing the various zones of the cerebral cortex; and it is extremely probable that the physiological division of function follows the lines of the embryological classification. He studied the human brain in both the fœtus and the infant, paying special attention to the maturation of the conducting organs—the nerve fibres. On completion of their development the nerve fibres are clothed with a special substance, *myelin*, which on account of its special chemical constitution is easily demonstrated by specific reactions and elective staining. Now the principal paths of sensation and motion, that is to say the nerve paths which proceeding from the periphery reach the cortex or leave this and extend to the motor organs—the so-called *projection*

paths of sensation and motion—attain their maturity much sooner than those which unite different parts of the cortex with each other—the *association paths*. The fibres lying in the depth of the cortex likewise follow this law: so that at certain periods of development there are cortical areas containing mature fibres in relationship with sub-cortical fasciculi of mature fibres, and other areas in which they are still entirely absent.

The topography of the centres which develop first corresponds in great measure with that already established by experiment for motion, general body sensation, olfactory, auditory, and visual sense. In the regions of late maturity there are included all the zones in which experiment has yielded more uncertain or absolutely inconclusive results. It is to be added that these last regions, while of very slight extent in the lower mammals, constitute in man not less than two-thirds of the cortex. From the above, Flechsig concludes that the first zones to mature are the centres of sensation and motion, *centres of projection;* the others—of late development—are *centres of association,* the seats of mnemonic images and of their combinations. In these centres it is also possible to recognise special periods at which maturation occurs, and thus accessory hypotheses have originated to which, however, this is not the place to refer (fig. 1 and 2).

Naturally numerous objections were raised to such an important hypothesis as that of Flechsig; but it was too firmly based upon fact to be shaken. From the psychic point of view there has been a tendency to distort the signification of the term association, by defining it as an elementary function of the whole nervous system without restriction to any one part of it. But this is a pure play on words. This thesis can only be sustained by granting to the term *association* the generic and wrong meaning of *connection* of every kind. But such is not its meaning in psychology; it is

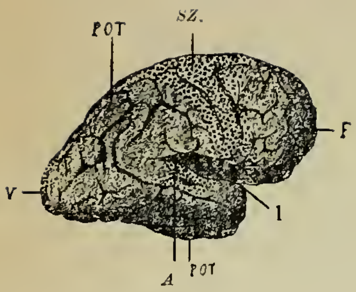

Fig. 1.

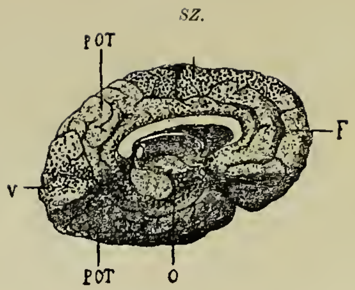

Fig. 2.

Figures 1 and 2.—Diagrammatic representation of the centres of projection and association (after Flechsig). Fig. 1, external surface of the cerebral hemisphere; fig. 2, internal surface. The dotted areas represent the centres of projection. SZ, somæsthetic zone, centre for the muscular activity and the sensibility of the body; V, visual zone; A, auditory zone; O, olfactory zone; F, frontal associative zone; I, associative zone of the insula; POT, parieto-occipito-temporal associative zone.

employed exclusively to indicate the connection between representative images which renders them capable of being evoked one after the other according to the order in which they were recorded. Further, psychologists have used the term association in this strict sense, as a standard for the estimation of intelligence, and in observations in comparative psychology.

The function of memories must be different from that of actual perceptions in the mechanism of association; an actual perception can unquestionably call up a memory or representation by association; but a memory does not evoke a closely related perception, nor are perceptions awakened by associative processes. If they were we should be constantly suffering from hallucinations.

The elements which go to form memories and representations are connected by true associative relationships; therefore if the partial representation of an image is called up, the total image easily comes into the consciousness; and one image can evoke others. On the other hand, the elements forming the perception have natural, objective, and invariable relationships of coexistence and of sequence, which do not depend on the internal activity of the subject or on any effort of association, but only on the spatial and chronological order of the sensory stimuli. If, after having looked at a figure, we cover part of it, we shall see only part of it, and the perception will never become complete of itself; but the representation of the figure can be completed by association. If while listening to the performance of a well known piece of music, it is interrupted at a certain point, association will not complete the auditory perception by an hallucination, but will do so exceedingly well in our imagination by means of memories. It is quite natural that this should be so; the biological aim of perceptive processes is to provide us with exact knowledge of everything going on in the

external world; the biological aim of memory and ideation is to complete the data of experience in time and space associatively, thus allowing of conjecture on what is not directly perceived, of remembering the past and of foreseeing the future.

The conception of *perceptive centres* consequently is quite legitimate; in these the image is called up by the external stimulus and completely vanishes when this ceases, just as the image disappears from a looking-glass when the object is removed. The conception of *associative centres* is equally justified; in them the traces of experience are stored and they are able to form definitely arranged relationships there, namely relationships which regulate mutual evocation. The perceptive centres then can evoke images and awaken associations by stimulating the centres containing them, but they are neither the seat of associations nor the place to which associative stimuli are directed.

The details upon which Flechsig founded his hypothesis were also attacked but without detracting from the principle involved; still it was shown that Flechsig's statements as at first enunciated were somewhat too absolute. For example, there is a small number of association fibres in the projection centres, and there are projection fibres in the presumed association centres; the chronological order of maturation is not so strict as one would be led to suppose; there are individual variations; some association centres show a singular precocity of myelinisation which does not agree with the law of parallelism between ontogenesis and phylogenesis; there is not an exact correspondence between the areas mapped out by Flechsig and those indicated by structural differences in the cortex.

The presence of a few projection fibres in the association centres—a fact recognised by Flechsig himself—cannot diminish in any way the value of the law, that there are chronological differences in the order of develop-

ment; besides, it is not demonstrated that all the projection fibres are of the same import, and represent an equal degree of psychic maturity. There are fibres which arise in the association centres and end in the basal ganglia, especially in the optic thalamus. Now it is known that this complex organ contains cell stations for the sensory paths, but it also includes special centres which in all probability are connected with the nerves subserving the faculty of mimicry, with visceral innervation, and with the mechanism of the emotions; it is not surprising, therefore, that even the association centres can acquire, in phylogenetic development, fibres destined to act on these thalamic nuclei and to awaken emotions by stimuli which originate in the centres of representation.

It was foreseen that the chronological classification would not harmonize with the presumed law of onto-phylogenetic parallelism, for the reason that this law is very far from having the strictness imputed to it by its discoverers and dogmatically put in schematic form by those who expounded the doctrine of evolution. It is known that organs acquired late in phylogenesis, but which assume an unusual functional importance, appear ever earlier in embryonic development.

It is very natural that the chronological order of development does not follow Flechsig's scheme rigidly —a scheme necessarily based on limited observations on account of the long study and toil involved—and shows individual variations within certain limits. The human brain, on account of its complexity, is clearly one which necessarily must show great individual differences. Everyone is aware how very sensitive the process of myelinisation is to disturbing causes; it is hastened by precocious functional stimuli, a fact verified by Flechsig himself in cases of premature birth; it is retarded by inanition, and probably is modified by a thousand morbid causes capable of influencing nutri-

tion. This fact more than anything else furnishes us with an anatomical basis on which to make clear one reason at least for so many individual differences in psychic development. Is it not possible that morbid causes, above all of a toxic nature, acting as is their custom in an elective manner upon this or that system, may hasten, retard, favour or prevent its development? The pathology of the nervous system provides additional facts which justify us in accepting this hypothesis, one which might lead to new discoveries if taken as a guiding principle and advanced along special lines of research.

There is no doubt there are some differences between the data of Flechsig and those furnished by Brodmann and Vogt's systematic study of the structural variations of the cortex. The latter show us characteristic differences which are more exact and minute, and which agree with the more recent and accurate experimental data. But this is no valid reason for denying the value of Flechsig's observations and for asserting that the myelogenetic *method* is not sound, and that its results are to be rejected. Here we are not treating of the choice between two methods employed for one and the same purpose; we are rather comparing *two series of different facts*. If Flechsig's observations are exact they cannot be resisted; their disagreement—after all very slight—with the data of cortical histology represents at the most a new problem which must not be lost sight of, but studied and solved.

We must admit therefore that the fundamental fact discovered by Flechsig is beyond dispute. In the cerebral cortex of man there are centres of later development which have less direct connection with the projection paths, and the presumption is justified that in them functions of a more complex and of a higher nature are located. These centres are acquired more slowly in the evolution of the species, and the comparative anatomy

of the brain fully endorses this view. Moreover Cajal, while studying development with other methods, has demonstrated that differences analogous to those of myelinisation and in harmony with them are found in the development of other histological elements, namely, the nerve cells and the axis-cylinders. Finally, observations on cerebral pathology agree completely with this hypothesis, and have demonstrated long ago that in the human brain there are unilateral cortical centres (centres of speech) which are not in direct relationship with the projection paths (of sensation and motion), but elaborate more complex relationships, and must be considered as higher in the functional hierarchy.

The doctrine of Flechsig must certainly, however, undergo constant reconsideration as fresh facts accumulate. One of the most immediate tasks awaiting the anatomist is that of determining in man and in the various animal species the chronological order of development, not only of the myelin but of all the other histological elements. From these embryological results and from those of the anatomical examination of the adult cortex combined with the data of physiological experiment and with observations in comparative psychology, an exact and complete localisation of the functions of the cerebral cortex will be established in time.

But with that the task of anatomy in the elucidation of these arduous questions is not completed. Granted that we have all these data at our disposal we certainly should succeed in localising in specified cortical territories some functions *en bloc*, but we should still be unable to follow their mechanism in detail. The cortex would be an organ of distinct function, region for region, but the function of the various strata of any single territory would still be undefined. In order to advance further it is necessary to investigate the signification of the cell layers.

As we already pointed out, the whole cerebral cortex was at one time considered to be of homogeneous structure. It was thought that the diversity of function, already demonstrated by experiment, could be explained by the difference in the connections existing between the diverse parts of the cortex and the nerve paths coming to the brain or directed away from it; thus, the visual cortex acquired its specific signification through its relationships with the optic radiations, the motor cortex by its connection with the pyramidal bundle, the path of voluntary innervation.

Recent studies have greatly increased the subdivision of the cortex into strata, and have demonstrated in it a more complicated apparatus than was previously supposed to exist. The local differences between one region and another have not all the same importance: there are some relating to the total depth of the strata which are less essential; there are others more important relating to the number and arrangement of the layers and to the morphological characters of the cell types. The regions which show the greatest differences are especially those in direct relationship with the projection paths of sensation and motion; the associative cortex shows less pronounced differences. It may be added that the local modifications are more accentuated in some layers and much less in others; thus the middle layers in which the projection fibres arise or terminate are more variable; while the superficial layers, and in particular that containing small and medium pyramidal cells, present an almost constant uniformity throughout the whole extent of the cortex.

What criteria have we for determining the physiological value of these layers? The first and most important is supplied by anatomy itself. Some of these layers are in more direct connection with nerve paths whose function is known with certainty or inferred with a certain degree of probability. For example, we

know that in the motor cortex, where the general sensibility of the body is also localised, the efferent motor fibres originate in special groups of giant cells which are situated in a particular layer, and can be regarded as the most direct organ of cortical movement. Another and somewhat thick layer, characterised by the presence of numerous small cells called granules from their minute appearance, is traversed in all directions by a dense plexus of afferent sensory fibres; it is therefore quite permissible to consider this layer as one set apart more especially for the reception of stimuli and for their first elaboration. And as a matter of fact, in other portions of the cortex in which the sensory centripetal paths end directly, the abundance of granules is noteworthy, and they form a very thick layer composed of numerous types which differ in their morphology and connections. On the other hand the superficial layers, the so-called molecular zone, and that of medium and small pyramids, provide, for the most part, connections with inter-cortical paths, long and short, homo-lateral and contra-lateral: consequently we must attribute to these layers a generic function common to the various cerebral regions, which is very probably related to the mechanism of association.

Nor is there any reason for surprise that these strata are met with also in the projection centres. These centres, if they are not stations of arrival for inter-cortical associative paths, are at least the places from which these paths depart to go to associative centres, and establish there a kind of projection of a higher order.

Comparative anatomy gives us other criteria but of an entirely generic nature. Without doubt we must assign a greater importance in the performance of the highest psychic functions, to those layers which have been seen to be more conspicuous, richer, and more complex in man, and in the highest mammals.

Pathology also helps us with some data. It seems,

for example, that in many cases of a very common mental disease—dementia præcox—there is a profound disturbance of the affective state and conduct, while sensibility and motion are intact, and memory and association quite well preserved. Now the anatomical examinations of the brain conducted up to the present time, show clearly that there is a lesion which is most marked in certain deep layers of the cortex which are neither in direct relationship with the sensory or motor nor perhaps even with the association paths; these layers are much more developed in man than in even the highest mammals.

But minute particulars of the functional mechanism of the cerebral cortex will not be elucidated unless anatomical and functional analysis is extended to the finest elements. When we know the general principles and details of the physiology of the elements constituting the nervous system, and the signification of the morphological differences which these elements show, then we shall be able to explain deductively the particular mechanisms which searching anatomical analysis will demonstrate in the cortex. We do not yet possess a complete doctrine of the manner in which the nerve elements functionate, and the particular conceptions regarding the morphology of the individual organs are still incomplete; nevertheless we are in a position to formulate hypotheses, not quite devoid of probability, which, if they do nothing more, help to stimulate research in what is apparently the most profitable direction.

Our knowledge of the *structure* and *connections* of the nerve elements has been systematically arranged only recently. It was known for quite a long time that there were cells and fibres in the nervous system, and while the former were regarded as the seat of dynamic elaboration, the fibres were considered to be simple

Fig. 3.

Fig. 4.

Figures 3 and 4.—Neurones with long axons (cells of type 1 of Golgi). Fig. 3, pyramidal cell from the cerebral cortex. Fig. 4, Purkinje cell from the cortex of the cerebellum. d, dendritic arborisation; a axon or nerve process; c, collaterals; cyl, axon which forms the axis-cylinder of a long fibre.

organs of conduction. It was recognised, too, that the cells were provided with numerous processes, and that they gave origin to fibres, and it was supposed that the fibres originated sometimes directly from a cell, sometimes in an indeterminate way from the nerve network of the centres.

The *neurone doctrine* arranged this collection of defective and disconnected facts, and owed its origin to the rapid development of our knowledge regarding the morphology and connections of the nerve elements, thanks to the use of a new technique, *Golgi's method.* By this method a silhouette of every detail of the nerve elements was obtained. S. Ramon y Cajal contributed a vast number of facts to this subject and his work was responsible for much of the investigation which followed.

According to the neurone doctrine the nervous system is merely an aggregation of cellular units just like any other organ; with this exception however, that while each cell of other organs is as a rule confined within a microscopic circle, the *neurones,* the elementary units of the nervous system, are provided with offshoots which sometimes are of considerable length. The physiological necessity to which the nervous system responds, that of having to establish dynamic relationships between distant points, probably has developed this unique morphological peculiarity through adaptation.

The prolongations with which every neurone is provided differ morphologically and functionally. Some, possessing a structure closely resembling that of cellular protoplasm and therefore called *protoplasmic processes,* are generally speaking numerous, relatively short, and ramify in the ganglionic mass in which the cell body lies. They subdivide repeatedly like the branches of a tree and from this feature they are now called *dendrites* (fig. 3 and 4, *d*). Another and thinner process, usually if not always single, is clearly seen to

spring from the cell body, and splits up sooner or later into fine fibres which in their turn may undergo further sub-division. This is the nerve process, neurite, or axon (fig. 3, 4, and 5, *a*). One of Golgi's discoveries was that the ramification of the axon of some neurones occurs in the neighbourhood of the cell (fig. 5); in others it is projected away from the cell as a distinct structure to form the central axile portion, the so-called axis-cylinder of a nerve (fig. 3 and 4), and reaches other more or less distant centres and peripheral organs, where it splits up into terminal arborisations. By these observations the supposed double mode of origin of nerve fibres was explained. There is no doubt now that every fibre springs directly from a cell and terminates by arborising in the centres or peripheral organs (fig. 6). Up to the present we know of no exception to this rule. The axis-cylinder is the most essential part of the fibre. The myelin sheath possesses an accessory function which is possibly that of isolation, and is absent in the finest fibres and in the last branchings. The peripheral nerves have a special coat, the sheath of Schwann, divided into small segments by special cells which do not form an integral part of the neurone. A nucleus surrounded by a small quantity of protoplasm is incorporated in each segment (fig. 7).

The physiological *law of dynamic polarisation* has been deduced from the orientation of the individual neurones in the nervous system, and from their reciprocal relationships of connection. According to this law every neurone receives stimuli either on the surface of its cell body, or on that of the dendrites. The axon, however, is reserved exclusively for the discharge of stimuli, conveys the products of cell activity outwards, and by means of the terminal arborisations discharges these products in the form of stimuli either on to the cell surface or dendrites of other neurones, or into motor organs. The orientation of the fibres is,

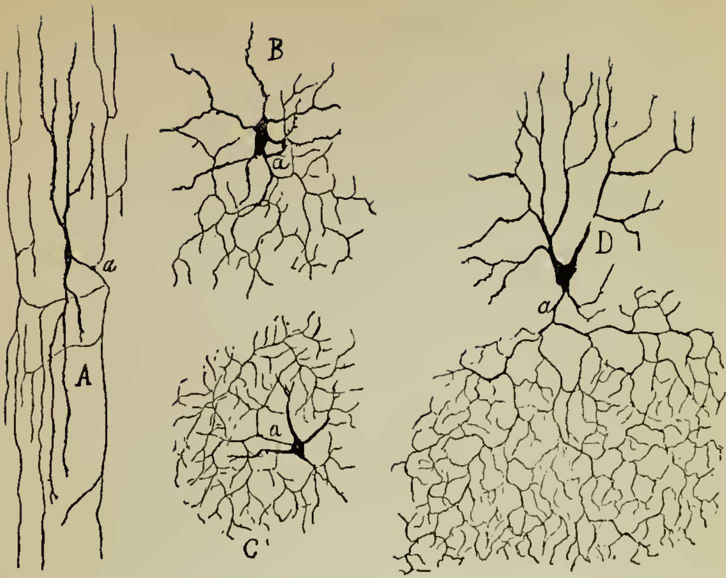

Figure 5.—Neurones with short axons (cells of type 2 of Golgi). A and B, from the cerebral cortex; C, from the corpus striatum; D, from the cerebellar cortex: a, axon minutely divided in proximity to the cell-body.

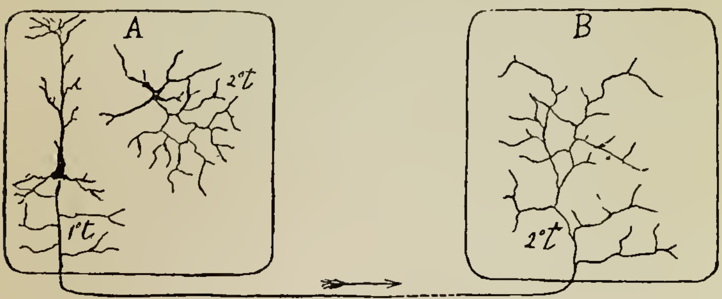

Figure 6.—Diagrammatic representation of the origin and termination of axons and their relations with centres and with nerve paths. A and B, two widely separated centres. In the centre A a neurone of the first type (t, 1) with a long axon is seen; this emerges from the centre, enters a long nerve path, indicated by the arrow, and goes on to terminate by splitting up and ramifying in centre B. Here it forms a fibre of the second type of Golgi (t. 2). In the centre A there is also seen a neurone with a short axon (t. 2), which ramifies in the centre in which it arises. The long axon, instead of terminating in a nerve centre, may form the nerve to a peripheral organ (muscle, gland) and end there by branching in an analogous manner.

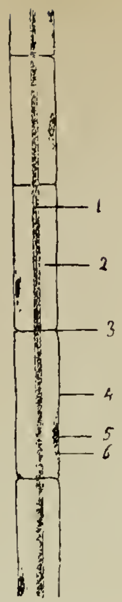

Figure 7.—Diagram of a portion of a myelinated nerve fibre in a peripheral nerve. 1, axis-cylinder; 2, myelin sheath; 3, node of Ranvier; which separates two contiguous segments; 4, sheath of Schwann; 5, nucleus of a segment; 6, protoplasm surrounding a nucleus.

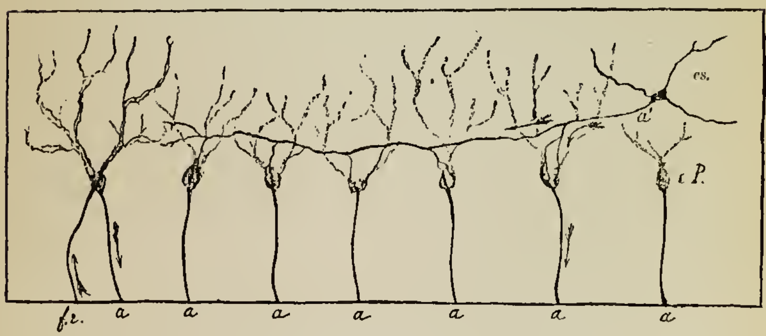

Figure 8.—A diagram illustrating the law of dynamic polarisation. The arrows indicate the direction of the nerve currents. cP, Purkinje cell from the cerebellar cortex, f.r. afferent "climbing-fibre" spreading along the dendritic arborisation of a cell of Purkinje; c.s. cell of the molecular layer which stimulates a series of the bodies of the cells of Purkinje by means of its axon a[1]; a, a, axons of Purkinje cells which conduct efferent nerve currents. See also figs. 9 and 10.

therefore, a certain index of the direction constantly taken by the nerve current, which is from the cell towards the terminal arborisations (fig. 6, 8, 9, 10).

The connection between the various neurones always takes place by the terminal arborisations of one axon wrapping themselves around the cell bodies and dendrites of other neurones. This relationship would be established by simple contact, without any true continuity between one neurone and another.

The analogy between a neurone and a cellular organism is also strengthened by this fact: in embryonic development all the prolongations of every neurone grow outwards from the body of the primitive nerve cell, the *neuroblast,* and thus the axis-cylinders of fibres, however long they may be, are only an emanation of the nerve cell. The sheath of Schwann which invests the peripheral fibres, is derived from special cells of totally different embryological origin.

There may be added still another important analogy. Every cell of the organism contains a special organ, the nucleus, which is of supreme importance in the life of the cell. If a unicellular organism is divided into two parts, of which one contains the nucleus and the other does not, the part with the nucleus repairs the loss and survives, while the other dies and is disintegrated in a short space of time. With the neurone the case is similar: if a prolongation is separated from the cell body and its nucleus, the detached portion degenerates and is liquefied, while that which remains connected with the nucleus not only survives but can even repair the loss—can regenerate the amputated fibre.

The neurone doctrine, owing to the clear manner in which it grouped the facts together and because of the innumerable applications to which it lent itself, was enthusiastically received for some years; but very soon all its most important points were subjected to lively

criticism. For a short period it seemed as though it might be shaken from its foundations; but this was merely transitory: criticism has stimulated a multitude of researches and it can now be asserted that the neurone doctrine has successfully resisted all the attacks made upon it.

One principle which raised the liveliest criticism was that the neurone was equivalent to a cellular unit. It was conceded at the most that the dendrites could be derived from the cell body, seeing that their extension is never excessively great; but it was regarded as inadmissible that an axon of a varying number of decimetres or a metre or even more in length could be a simple prolongation of the cell. As a matter of fact the axis-cylinders which leave the pyramidal cells of the cortex and pass uninterruptedly along the pyramidal tract to the lumbar and sacral cord, as well as those which extend from the motor cells of the sacral cord to the muscles of the foot for example, are really of such striking length. There was no similar example in the morphology of other organs; so that such a conception contrasted too greatly with the ideas usually held on the constitution of cells. It seemed preferable therefore to regard the fibres as possibly of pluri-cellular origin, formed primarily by a chain of cells, and to consider that every nucleus of the sheath represented an old cell, of which the corresponding portion of the axis-cylinder formed a part. Numerous studies on the development of nerves, carried out with a technique quite unsuitable for the purpose, led some to believe that this view was definitely sanctioned by exact observation. Even in studies of the regeneration in divided nerves there was a desire to attribute—by analogy—to the cells of Schwann's sheath the function of regenerating not only this structure but even the essential conducting portion of the fibre, the axis-cylinder. But although these cells exist in the peri-

pheral fibres they are totally absent in the centres, it was therefore obvious that here the processes of embryonic development as well as those of regeneration took place in an altogether inexplicable manner.

At length this discussion shows signs of closing. Numerous studies based on embryological observations in suitable tissues, on perfected methods, or on most ingenious experiments, have demonstrated that the axis-cylinders and the cells of the future sheath develop absolutely independently, and that a nerve at certain periods of its growth can be composed of naked axis-cylinders, and is only provided with its investing cells at a later period.

In correspondence with the above, it has been demonstrated that in the regeneration of nerves every cut axis-cylinder which is connected with its cell of origin produces abundant out-growths independent of any action of the ensheathing cells; in contrast with this the ensheathing cells alone, isolated from any possibility of connection with the central stump of the nerve, are altogether incapable of regenerating axis-cylinders.

The law of dynamic polarisation was the subject of much less criticism. Criticism did not damage its fundamental principles but corrected some of its equivocal points, and adapted it better to some particular cases of difficult interpretation.

The principle of relationship by contiguity, by simple contact without actual continuity between neurone and neurone, met with the most active opposition. The studies of Apáthy on invertebrates appeared especially to afford testimony in favour of a true continuity. But this is not one of the essential points of the doctrine. From the physiological point of view it matters little whether the neurones merely touch or penetrate one into the other, because in any case the functional current is always propagated according to the principle of dynamic polarisation, and the theory

that each neurone is originally an anatomical unit and develops quite independently of other neurons remains as sound as ever. Besides, the continuity of neurones in invertebrates is to-day disputed afresh; and so far as the vertebrates are concerned, up to the present not a single example of continuity between neurones has been observed with certainty, and that on the confession of those same adversaries of the neurone doctrine and of the supporters of the theory of continuity. The pericellular terminations assume different appearances according to the method by which they are demonstrated: at one time they show as small button-like structures; at another apparently these structures are crowded on the surface of the cell and its dendrites, fixing themselves there and forming a sort of mosaic; lastly, according to some authors they form by their fusion true superficial reticula, but in no instance is definite penetration into the interior of the cell observed.

This question is intimately connected with that of the structure of the nerve cell protoplasm and its processes. Although it was generally admitted that the protoplasm ought to show a fibrillar structure, even up to a few years ago there was no clear demonstration of the fact. It was really Apáthy who showed it distinctly in invertebrates and described the reticula within and between the cells.

The demonstration of the *neurofibrils* in the cells of vertebrates was of later date, and with this work the names of Bethe, Donaggio, and Cajal are especially associated. But the morphological appearances obtained with different methods were not identical. While Bethe with one of his special methods thought he had shown that the fibrils were absolutely independent, so much so as to induce him to believe that in the cell body no fusion of stimuli independently conducted by these fibrils took place, Donaggio and Cajal were able to

demonstrate very evident reticula. As a matter of fact, if one compares the results obtained by these methods with those of others invented later, it is seen that, although as a rule reticula are shown by all, their appearance is not at all identical : the reticulum sometimes appears coarser, formed of thicker trabeculæ, which therefore can be mistaken for isolated fibres; sometimes, on the other hand, it seems to be formed of the finest meshes, of very delicate and irregular trabeculæ, which, however, are parallel here and there, giving collectively the appearance of striation in a definite direction.

Discussion on these results is however very inconclusive, but perhaps a definite conclusion on any of the points is not to be expected. It is necessary to keep before us the fact that here one is treating of very minute elements, almost at the extreme of visibility even with the highest magnification, and that these fibrillar elements cannot be supposed to exist in life just as they appear to us under the microscope, because the microscopical examination is always conducted upon dead tissue which has been subjected to the action of reagents often more than energetic, even violent in their action. And without going so far as to admit that one is treating of artificial products, as some have suggested, it is however certain that structures so delicate, formed of colloidal substances very rich in water, must necessarily show a certain plasticity and must be extremely easily modified by the precipitating and dehydrating actions of histological reagents. That there is such a plasticity in the living subject is shown by the results of physiological and pathological experiments to which we must return later. Consequently we find ourselves at the confines of morphology, at the boundary line where the criteria of physics and chemistry are on the point of encroaching on those of pure anatomy.

The same can be said regarding the presumed con-

nections between the peri-cellular terminations and the internal fibrils. A direct connection, at least in vertebrates, has never been seen; while the peri-cellular terminations assume variable appearances according to the methods employed, and according to physiological and pathological conditions. As we shall see, other considerations induce us to suppose that these terminations must have a complex capacity of undergoing chemico-physical and perhaps morphological variations. Hence we shall not be astonished if the microscope does not yet succeed in solving a question in morphology which has less real existence than is supposed.

Let us now see if we can draw some deductions in psychology from these data regarding the anatomy and general physiology of the nervous system.

One of the problems which psychology has always put to anatomy is that of interpreting psychic evolution during development and adult life.

Anatomy gives us the general impression that organs are systems of unchangeable and rigid structure. How then can psychic plasticity be reconciled with this rigidity? The neurone doctrine is capable of giving us a satisfactory answer if we admit that between neurone and neurone there is some kind of constant or temporary discontinuity, no matter whether the relationship is established by contact or by means of plastic connections which undergo modifications most readily. If then we consider that the psychic maturity acquired in adult life is simply a continuation of development itself, the explanation will appear more clear and convincing to us.

The connections between the nervous elements are much more complex than can be conceived. Therefore embryologists have always been confronted with this obscure problem: in virtue of what mechanism are these connections established in an exact manner without any

deviation? To tell the truth the neurone doctrine with its postulate of the neurone as an anatomical and embryological unit does not diminish this difficulty. According to it the fibres of the pyramidal tract which arise from the large cells of the motor cortex and extend along the cord to its lowest level, must during development set out from the cells of origin and grow progressively to their ultimate destination, through a thousand obstacles and possibilities of deflection. How does this certain and rapid orientation come to pass?

Ramon y Cajal, the Spanish anatomist, explains the above phenomena by *chemotropism,* which means, that capacity of orientation in a definite direction possessed by cellular organisms in the presence of certain chemical stimuli. This doctrine, closely linked with that of cellular specificity, gives us the most exact explanation of nerve development. Every element of a given category possesses a distinct specific chemotropic sensibility which impels it towards other elements, and determines the direction in which its offshoots shall grow; at the same time each element contains or produces substances equally specific, which act as attractors of other elements towards the growing processes. If the elements are very widely separated then the probability is that intermediary chemotropic mechanisms intervene—formed possibly of different tissues—which roughly determine the route, leaving to more particular neurotropic affinities the further task of establishing the closest and most definite connections. Thus the peripheral nerves developed from their cells of origin situated in the centres or in their neighbourhood, would in the first instance be directed by generic chemotropisms and would then find, fibre by fibre, their physiological destination under the influence of particular tropisms. This process naturally encounters difficulties during development, and as a matter of fact studies in anatomy prove that

its completion is sometimes attained with some uncertainty and after repeated attempts. Further, evidence is not wanting to show that deviations from the natural process occur, which though remedied at once or later can leave traces observable even in the adult.

This doctrine of *neurotropism*, applied first to embryological development, is to-day corroborated by the observations on the regeneration of fibres in experimentally divided nerves in the adult. These experiments demonstrate that the new out-growths of axis-cylinders arising from the amputated stump of old axis-cylinders are guided to their destination by special chemotropic affinities. This is generic up to the point where the new fibres canalise the main path of the nerve trunks, but afterwards is specific when the single fibres, physiologically distinct, are endeavouring to reach their particular goal.

Neurotropism throws considerable light on physiological and psychological problems. It does not exclude the possibility that in certain organisms the connections between the various neurones are immutable. Such would be the case in those organisms which have acquired—by means of co-ordinated reflexes—adaptations of a high degree of perfection, but incapable of further improvement. Probably this holds in the case of the invertebrates. But where the structure of the nerve centres, although already highly organised is still capable of further perfection—especially in the cerebral cortex—it is clear that chemotropic activities can still be the factor in bringing about new anatomical relationships. Tanzi formerly explained the consolidation of memories and automatic actions which become habitual, by means of an ever expanding mechanism which tends to approximate and unite in a progressively more intimate manner elements connected with each other; with the same mechanism Cajal explains the formation of every new association, the process by which the cerebral

anatomical mechanism is perfected, and the progressive increase in anatomical pathways which constitutes the substratum of ideation, imagination, and foresight.

This plastic activity of the neurones, which is just a continuation of what is more accentuated in the embryo though in quite a different manner, is naturally more active in infancy and youth than in adult life. And that explains the particular plasticity of the young mind which education models so easily and which trivial incidents can alter for a long period of time or even permanently. To the same cause can be attributed the fact that after destruction of some cortical centres functional compensation—impossible in the adult—is possible in the child. This is clearly seen in disturbances of speech: lesions which give rise to irreparable aphasia in the adult do not leave any defect in the child, because the function can be organised in other seats, provided that the capacity of forming new connections is still present in the nerve paths. With the increase of years the plasticity of the neurones becomes quiescent, but very slowly, and in fact we see how the aged may become incapable of modifying their own convictions and of yielding to the suggestion of new experiences.

The whole process of nervous activity and even that of the highest intellectual faculties can be explained by a complex mechanism of tropisms. It might be remarked that in this way everything is reduced to an unknown quantity, tropism, which in its turn must be explained, a task by no means easy. But the new applications of physico-chemistry to the elementary activities of the organism already hint at a possibility of solution along the following lines, viz.: that variations of osmotic pressure or surface tension in relation with definite chemical phenomena may possibly provide the principles for an interpretation of the many manifestations of tropism.

In recent years there has been without doubt a strong

tendency towards the excessive use of tropisms in the interpretation of psychic life, especially in lower organisms; and already a reaction has set in against such exceedingly shallow explanations. But on looking closely into the question, these disputes do not in the least cast doubt on the soundness of the doctrine. The abuse which has been made of the theory consists in a desire to interpret as simple phenomena of tropism certain complex and variable acts of pluri-cellular organisms provided with a more highly complicated nervous system and with differentiated organs of sense. Such simplification is without doubt arbitrary. But it is not at all arbitrary to apply the conception of tropism to unicellular organisms or to the single cells to which the most complex nervous systems can be reduced, and to try to explain from what we know of these, the elementary actions into which the nervous function can be resolved. The opposite tendency—shown before tropisms were known of—according to which there was an inclination to explain the smallest movement of unicellular organisms by anthropomorphic psychological stimulus was erroneous. But when we analyse the most complex nervous mechanism anatomically and physiologically, when we reduce it to an elementary form of action—which is conceivably mechanical—we are on the right lines as indicated by all experience in biology.

Naturally there still remains to be explained how in this mass of tropisms each is endowed with specific characters and how hereditary transmission of these comes about. But this vexed question is not peculiar to the subject which occupies our attention at present; it is constantly found at the bottom of every biological problem. If, however, it is not of easy solution at the present time, some progress has been made by attacking it through the medium of other questions which at first sight seemed to have little in common with it.

Another series of special problems the solution of which is still looked for, though inferred in the meantime from the general principles of the physiology of the neurone, has reference to the *functional signification of the different types of neurones.* Although the neurones have one structural plan and are all provided with a cell body, dendrites, and an axon, nevertheless these organs differ immensely one from another in length, richness of ramifications, and in a thousand other morphological particulars. Such differences must be associated with diversity of function. As a matter of fact where it can be presumed that the functions are identical the morphological characters of the neurones are identical also. Every nervous organ then is constituted of various neuronic systems with distinct functions. Now the morphological characters are very similar within the limits of every system, very different on the other hand between system and system.

If we leave aside the minutest particulars regarding the richness of the ramifications and their individual form, we can create a broad distinction between neurones possessing a long axon—which is directed into a fasciculus of fibres and goes to terminate by ramifying in a ganglionic mass far removed from that in which its seat of origin lies (fig. 3 and 4)—and neurones possessing a short axon which terminates in ramifications within the same ganglionic mass (fig. 5). This distinction is not rigid, intermediate types exist; but that does not deprive the extreme forms of their typicalness to any extent; both are of very frequent occurrence in the nervous system and correspond, according to the nomenclature of Golgi, to the *first* and *second type.*

If the dendrites are receptive organs, then their extension indicates the limits of the field in which, neurone for neurone, the collection of stimuli must occur; if the axons are the organs of discharge, their distribution indicates the region within which the discharge

must be limited. One need not push the hypothesis far to come to the conclusion — granted that the functional significance of the axon is established — that neurones with long axons are organs destined to send to great distances functional energy elaborated in the grey matter in which their cell body lies, while neurones with short axons are organs for the elaboration and local distribution of stimuli.

If we look more closely into the morphology of the Golgi cell (the second type with short axis-cylinder) it is noteworthy that sometimes the dendritic arborisations extend only a short distance and are less extensive than those of the axon; sometimes, on the other hand, they cover a fairly wide area while the axon is finely branched in a narrow field and carries its stimuli to few other elements. It is not going too far to conclude that the function of the first is to diffuse stimuli, of the last to concentrate them. The physiological aim of these different actions cannot be surmised so long as—for want of complete knowledge of their reciprocal connections—we are ignorant of the nature, origin, and objective of the stimuli.

In the neurones of the first type with a long axis-cylinder, the following fact is frequently observed. The axon, before leaving the ganglionic mass in which it arises, and before passing into a fibre bundle, gives off some few collateral branches which terminate in the midst of elements analogous to that from which the ramification emanates (fig. 3, 4, 10). The fact can not be excluded that these collaterals also come into relationship with neurones with short axis-cylinders. If they, like the entire axon, conduct cellulifugally, it must be concluded that every element with a long axis-cylinder, in the act of transmitting its own discharge to a distance, excites directly or indirectly by means of small collateral discharges homologous

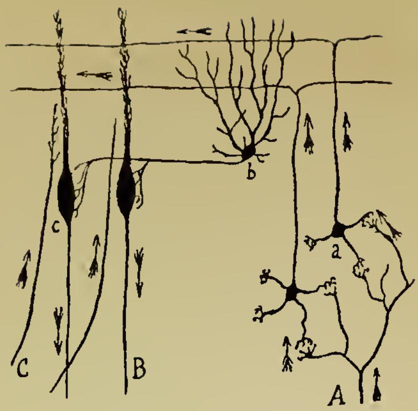

Figure 9.—Diagram illustrating the transmission of nerve currents in the cortex of the cerebellum (after Cajal). The arrows indicate the direction of the currents. A, "moss-fibre" conducting stimuli to the granules (a); B, axon of a Purkinje cell (c), the organ of discharge; C, "climbing fibre" which conducts stimuli directly to the cells of Purkinje; a, granule which by means of its T-shaped axon stimulates the cells of the molecular layer (b) and the dendrites of the cells of Purkinje; b, cell which by means of its axon stimulates the bodies of the cells of Purkinje. See also fig. 8.

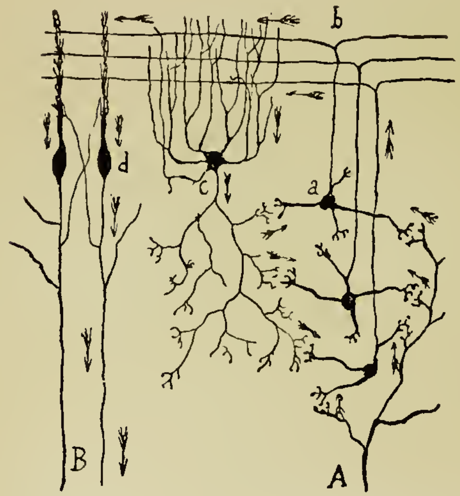

Figure 10.—Complimentary diagram to fig. 9 (after Cajal). A, "moss-fibre"; B, axons of cells of Purkinje (d); a, granules; b, T-shaped axons of granules which stimulate the dendrites of the large cells of Golgi (c); c, large cell of Golgi which, by means of its minutely branched axon, stimulates many granules and thus establishes a complete circuit for stimuli.

neurones also, so forcing them to participate in the action.

Sometimes even more complex relationships can be demonstrated. Some ramifying afferent fibres terminate in contact with neurones possessing a long axon whose function is one of discharge, and thus establish a simple reflex arc: others stimulate elements with a short axon, which in their turn effect a new series of distribution and diffusion of stimuli. These stimuli, directly or indirectly (by means of intercalated neurones) are finally discharged on cells with long axis-cylinders. Thus besides the direct path there is an accessory, longer, more complicated, and more diffuse one. In this way sometimes a grouping of various orders of elements is established in the form of a circle, so that the stimulus, should it not be weakened in transit from one element to another, or enfeebled from other causes, would never be completely dissipated. A most illustrative example of these multiple connections was shown by Cajal in the cerebellar cortex (fig. 9 and 10).

Cajal holds that the function of the cells with short axons is to reinforce stimuli: they would thus be *condensors* and *accumulators* of nervous energy, and their action would be to *increase the energy of the discharge*. There is no doubt that this conclusion is quite legitimate, but another can be drawn which has reference to a function perhaps even more important. With the mechanism just described stimuli become not only diffused and reinforced but their action is also *lengthened*. The reactions of the nervous elements are immediate and very rapid. A cell on stimulation reacts with a discharge and returns to rest; to the discharge there also succeeds a very short pause during which the nervous element is not further excitable and the process of chemical redintegration takes place. If the connections between the neurones were established in an altogether simple and direct fashion, the reactions would be

instantaneous and intermittent, *i.e.*, *clonic*. If, on the contrary, the stimulus is diffused through many elements and lengthened by passage through indirect paths and internal circuits in the brain, then a fusion of single clonic discharges into a continuous and protracted reaction can occur, *i.e.*, into a *tonic* reaction. This conclusion will appear more probable if we find that the organs in which these internal circuits are present react precisely in the manner indicated.

The organs which are richest in Golgi cells with short axons are the cerebellar and cerebral cortex, and the corpus striatum. The cerebellar cortex is probably intended to carry out reflexly the function of equilibration, one called into action constantly, and requiring fusion of stimuli to a remarkable degree; and it is perhaps for this reason that the cerebellum has so much influence on muscular tone. The cerebral cortex has the most varied and complicated functions and it is not easy while analysing its individual functions to see what part each plays in maintaining in action and prolonging stimuli. But if we compare the psychic functions as a whole with purely reflex functions, especially with those concerned in motor action, we see there is a remarkable difference which has a direct bearing on the present argument. Reflexes follow a stimulus at a very brief interval of time, and almost invariably cease coincidently with the stimulus; instinctive acts are always determined by actual stimuli, by some more or less urgent need on the part of the organism, but they are often simpler than is imagined; only volition is capable of providing continuous and almost indefinitely prolonged reactions. If one wished to define the voluntary act, nothing could represent it better than a prolonged effort maintained without any need of external stimuli. And perhaps, too, the following fact has some significance, that in catatonia—a disease in which the maintenance of a rigid, statuesque pose is characteristic—the most obvious morbid changes are found in the

deepest layers of the cerebral cortex singularly rich in these elements with short axis-cylinders which distribute stimuli into the substance of the cortex; possibly the spasmodic rigidity is determined by an irritative condition of these cells. As regards the corpus striatum we know very little with certainty. Its deep situation has rendered it up to the present almost inaccessible to experiment, and its proximity to numerous nerve paths has deprived the data of pathological observation of certainty or value. But the most recent experiments of Pagano, carried out by introducing a solution of curare directly into the corpus striatum without inducing lesions in other parts, have demonstrated that this organ has special relationships with visceral innervation and the mechanism of the emotions. Now visceral innervation is eminently a tonic process, and it is characteristic of the emotions that they continue longer than the stimuli which have determined them and that they are diffused and intensified even after the primary stimulus has ceased.

One of the clearest laws in connection with the organisation and function of the nerve centres is that aptly called by Ramon y Cajal, its discoverer, the *law of avalanche*. We have seen that from every neurone the product of dynamic activity of the cell body is transmitted by means of the axon, and that this divides, and ramifies either near its point of origin or remote from it. It is thus able to carry stimuli to a very variable but almost always large number of cellular elements. If the grouping of the neurones along a sensory path is examined, it is evident that a stimulus which is a single unit at the periphery must reach the cerebral cortex split up into an extremely large number of fine sub-divisions. From a cone or a rod of the retina the stimulus does not pass directly to one fibre of the optic nerve, but can excite more than one through a multiplicity of chains of retinal neurones. Each fibre of the optic nerve

on reaching the external geniculate body comes into relationship with numerous cells in this nucleus, and the fibres arising from these and forming the optic radiations passing to the visual cortex, do not excite isolated elements there but spread in all directions throughout a special layer. Here they run parallel to the surface and split into minute branches, placing themselves in contact with thousands of nerve cells which in their turn distribute in a complicated fashion the stimuli received.

From this anatomical law various inferences can be drawn important in physiology, psychology, and the pathology of the nervous system.

First of all there is no ground for the belief in a kind of cortical retina whose individual points correspond to those of the retina itself and of the visual field. There is a rough and partial topographical correspondence: the cortical images are divided in the two hemispheres of the brain; the right half of what is presented to our view is projected into the left occipital lobe, and the left into the right. The ultimate precise distribution of the stimuli in each visual cortex is accomplished in quite a different fashion. While in the retina—essentially an analytical organ—the sensory elements are arranged as the stones of a mosaic, in the cortex a large field of projection corresponds to each point of the retina. And perhaps even the most definite stimuli at the periphery—those of the *fovea centralis*—are, in the centres, projected over the whole visual surface. After minute analysis of this anatomical mechanism I have sought to demonstrate in a previous work that for the correct co-ordination of the visual stimuli it is not at all necessary that they should assume topographical relations in the cortex analogous to those of the retinal stimuli, but that it is only necessary that the individual stimuli should assume with each other correct relationships of co-existence and sequence. Cerebral processes certainly sym-

bolise external phenomena and objects; but this symbolism cannot be interpreted as a rough analogy of forms, positions, and mechanisms: perhaps the resemblance between a cerebral process and the external phenomenon symbolised by it is not greater than that which exists between a verbal sound or written word and the object which it indicates.

The law of avalanche holds also for all the other sensory paths; and although it cannot be maintained that every elementary peripheral stimulus must be reflected on the entire cortex which subserves the corresponding sense, it is however certain that diverse stimuli must be projected on very extensive fields which overlap to a very great extent. Anatomical analogies induce us to admit a similar topographical distribution for the highest products of psychic activity, for memories, representations. This hypothesis finds support in many interesting and characteristic data in connection with the pathology of memory.

In dementia in general, but more especially in senile dementia, the loss of memories occurs in two characteristic phases. At first the memory can no longer be evoked spontaneously or only with great difficulty, but is recalled and recognised as a memory when suggested by another person. Later not even this kind of evocation is possible: the memory has disappeared altogether. Still it is noteworthy that the oldest and most intimate memories are the last to disappear, while the more recent or those which represent the fruits of less frequent experience are the first to vanish.

If we admit that every image is lodged in a very extensive cortical network and that the anatomical networks corresponding to the more habitual images, to the memories more frequently repeated, are denser and more extensive, we are thus able to explain to ourselves the mechanism of these progressive amnesias.

The anatomical lesions which are minute and irregularly diffused throughout the cortex in these dementias, cannot destroy these cortical networks entirely or one by one. They only diminish their richness and progressively induce disconnection. The greater the deficiency in one of these networks the more difficult is the evocation of the corresponding image; but still it is not impossible, and what cannot be accomplished by slight and fleeting stimuli of ideative association is evoked by the strong stimulus of a sensorial impression, such as that of a heard word. It is only when the lesion is very extensive and profound that even the evoking influence of strong sensorial stimuli fails utterly. And in such a case it will be easily understood how the less extensive and more debilitated anatomical networks must be the first to lose their functional capacity entirely, and how they must also be the first to show a relative deficiency of function.

The pathology of speech provides us with some remarkable examples in which all the disturbance of memory is limited to the impossibility of spontaneous evocation. In the syndrome of amnesic aphasia, spontaneous speech is lost or is limited to a few of the most commonly used words; the patient seeks in vain for terms in which to express his thoughts, thereby experiencing great discomfort; but the word sought can be pronounced quite well if suggested by others, and the patient estimates its exact meaning and recognises whether it is suitable for the expression of his thoughts or not. In such cases therefore the comprehension of speech is intact and the capacity of articulation preserved; only the mechanism of evocation of verbal images is disturbed. On this account there has been a desire on the part of some to explain verbal amnesia as being due not to a lesion of the articulatory centre or auditory word centre, but to interruption of the associative paths between the centres of speech and a

hypothetical ideative centre. But this hypothesis has received no confirmation from post-mortem examinations; these on the contrary lead us to admit that the amnesic syndrome is due to direct but partial lesions of the very centres in which lie the anatomical networks that are the seats of the representations of spoken language. In favour of such a hypothesis this fact speaks very strongly, viz.: that verbal amnesia can be present in its most characteristic form when the lesions are not focal but only minute and diffuse. Besides the observation of transitory verbal amnesia in cases of grave nervous exhaustion is very significant. Here the anatomical networks must be regarded as intact although functionally weak.

Those who specially study comparative psychology are always greatly exercised with the search for an *objective standard of consciousness,* an objective standard which would enable them to judge whether a given animal has or has not consciousness, whether a given action accomplished by it is conscious or not.

For some time it was held that such a standard must consist in the animal's capacity for intentionally directing its own acts or movements. But this standard had only the outward appearance of objectivity. It was based essentially on the purely subjective assumption that the animal intentionally directing its own movements, had a clear perception of all possibilities, of its relationships with these, and that it made its choice. The fallacy of this standard was at once revealed on applying it to the so-called psychology of the unicellular organisms. In these it was asserted there existed a number of psychic attitudes similar to those found in man, but the study of tropisms showed that the movements observed were under the control of a very much simpler mechanism. Besides, according to the above standard it could be admitted that the iron filings attracted by the magnet,

objects which fall to earth and the projectile which pursues its definite trajectory consciously follow the dictates of their own will as a result of conscious choice of purpose and method.

Let us look at a totally different issue in the argument. Even at the present day the qualities that imply superior faculties, which probably fall short of consciousness, are sought for in the acts of animals. Some believe, for example, that animals which give indications of recognising objects and events, or of profiting by experience, are conscious. But to recognise, means to preserve memories and compare them with actual pictures; to profit by experience, means to preserve memories and co-ordinate them according to new relationships of co-existence and sequence. Now we can reasonably grant that these psychic acts are the basis of *intelligence* properly so-called, but not of *consciousness*. Among conscious processes we include those which are stirred up by actual impressions, quite independently of the traces which they leave; consequently we can imagine a consciousness which does not include past time in the slightest degree, but which is limited to the reflection of the events of the moment—a purely sensorial consciousness.

From what can we deduce that a process of recognition occurs, or that experience has carried profit with it? From nothing else than the animal's behaviour. Now we cannot grant that this is an absolute standard. The most simple reflex acts, to which no psychic value is attached, are themselves an acquired product of the activity of the nervous system, attained through a series of progressive modifications; and if to-day we recognise their immutability in general, we must grant that this is due not only to hereditary qualities of the organic apparatus by which they are accomplished, but also to the qualitative and quantitative constancy of the stimuli which awaken them. If by repeatedly exciting a reflex

with stimuli modified in some unaccustomed way, we succeed in modifying its habitual conduct, should we therefore say it is no longer a reflex but has become a conscious act? Certainly not.

The anatomy and physiology of the nervous system may possibly provide an objective standard of consciousness when we succeed in elucidating some at least of the objective conditions common to all conscious processes and characteristic of them. Have we any such standard at present? I maintain that the standard so well established by Tanzi is correct.

Subjective observation has always shown us that the essential character of consciousness—without which we could not comprehend consciousness itself—is the act of establishing relationships between diverse impressions. The most elementary of sensations appears clear in our consciousness only because it has definite antithetical relationships with others from which it is distinguished; in other words, there is no consciousness without distinction, and the clearness of consciousness is in strict proportion to the distinction. Therefore subjective analysis provides us with a primary standard with regard to the quality and complexity of the relationships which must be established between the elementary impressions in order to have a clear distinction; with this standard as a guide, combined with the general principles regarding the function of nerve units, we are able to make some probable conjectures as to the sufficiency or otherwise of the nerve connections of the individual centres, that is, to find the anatomical standard sought after.

Tanzi points out that if from the subjective point of view the distinctions demand, as a necessary condition, the formation of multiple, precise, and constant relationships between the various sensations, it is necessary that from the objective standpoint the dynamic processes which form their substratum should present the same

multiplicity, precision, and constancy. And therefore the individual stimuli coming from the outside world must be separately conducted to the centre, and combining there, assume the most varied but definite relationships, and become intimately united with the accurately localised records left by former processes. And since all the possible and varied symbolic constructions which constitute conscious phenomena result from the grouping together of the elementary distinctions, it is necessary that all the dynamic processes corresponding to the elementary distinctions develop with orderly distribution in an individual centre, and assume there the most varied relationships of combination corresponding to the single groups of distinctions.

That being established, it appears clear that all the connections established in the nerve centres do not satisfy entirely the conditions necessary for the production of states of consciousness. The biological aim of the nervous system is to make the organism react to external action for the sake of self-preservation. Consequently the first aim of nervous co-ordinations and connections is to establish the necessary relationships between sensory and motor elements for the fulfilment of special reactions; and the first centres which appear in phylogenetic development are precisely directed towards giving special reactions to special stimuli. Only later, with the accumulation of adaptations, does the formation of a single superior directing mechanism, general and synthetical, become of advantage; in this mechanism all the external impressions may be gathered together and systematically co-ordinated, and the special reaction to the special combination of stimuli elaborated. Only in this mechanism, which affords the possibility of general, complex, and systematic relationships, are the conscious elementary distinctions possible, from whose general co-ordination results the symbolic

representation of the external world, of the organism, of the reactions of which this is capable, and of the power of adjusting these so as to check according to necessity the prejudicial actions continually and insidiously attacking from outside.

Minute anatomical analysis furnishes us with the elements necessary for judging whether special co-ordinations destined to give compulsory and invariable reactions exist in the individual centres, or only diffuse co-ordinations of an independent nature similar to those which have been admitted as conditions of consciousness. On this point we cannot enter into particulars which would demand minute explanations of a technical nature, but we can affirm that only the cerebral cortex, in the nervous system of mammals, fulfils all the conditions required. In it the projection fibres of every sensory path are distributed, ramifying very freely in fields which overlap to a very great extent. By means of this arrangement, which realises the avalanche distribution of the stimuli spoken of by Ramon y Cajal, every elementary stimulus is subdivided into innumerable units, which at innumerable points can be placed in contact with other stimuli, whether of a similar or dissimilar nature; other elements collect the product of elaboration which has taken place and project it in other cortical fields where the associative paths coming from various areas of special sense come into contact, and where by means of the same mechanism the stimuli acquire new relationships of a higher order; so that putting all together one may say that there is not a single impression proceeding from any organ of special sense, or from the muscles or viscera, which cannot assume a direct or indirect relationship with all the others. The co-ordinations which are observed in the lower centres show us clearly how these are destined to give special and constant reactions, and to serve as stations of passage and distribution for the nerve

currents of the sensory paths ascending towards the centres, as well as to the motor currents which leave these to act on the last order of neurons directly concerned with the innervation of the muscles.

Are we justified then in concluding that the cerebral cortex is the only organ in which consciousness resides, and that in organisms constructed on a totally different plan and without such an organ consciousness is impossible? Certainly not. It is even probable that in the zoological scale there are analogous structures in which similar co-ordinations are accomplished, and that these also can be regarded as seats of conscious states. And if the cortex and these organs show innumerable gradations of development, our conclusion will be that conscious processes in them are not equally rich and clear, but that consciousness is gained step by step with the higher development of the organ.

I believe that if we take as our basis the most general data of subjective psychology, of the anatomy and physiology of the nerve centres, we are justified in pushing still further afield and advancing a hypothesis regarding the *distinct localisation of the organic processes which form the substratum of the phenomena underlying the comprehension of the external world and the affections.*

Psychological analysis shows us that any psychic phenomenon whatsoever, from the simplest to the most complicated, presents a dual character—two different aspects—of which now one, now the other, is more predominant; these two aspects are, however, always intimately connected with each other. The psychic phenomenon as it presents itself to us includes not only comprehension but also the affective state associated with it: comprehension is referred to the objective world, the affective state to our own personality. As we have already seen, comprehension

symbolizes an external relationship, while the affective state symbolizes the biological relationship of the organism with the external action; this relationship is different according as the action is beneficial in character or the reverse. Now I think the hypothesis that the two processes are differently localised is quite justifiable; that is to say, that in the nervous centres there occur two distinct elaborations of external impressions; one more especially connected with anatomical conditions and developed amongst the terminations of nerves afferent to the centres, therefore *inter-neuronic*; the other, especially related to dynamic and nutritive conditions, is developed in the body of the cell, therefore *intra-neuronic*. The first corresponds to the processes of comprehension, the second to the affective phenomena.

From the general doctrine of specific energies, which is perfectly compatible with the above-mentioned theory of chemotropism and of its rôle in the development of nerve connections and the establishing of new relations throughout life, we must admit by deduction that every nerve termination which reaches the cortex possesses *specific* physico-chemical characters.

Functional activity must determine some active modification in these terminals, without which it could not act upon the other neurons with which relationships take place. Consequently, nerve terminations of different origin and signification which exist in the brain in great numbers and overlap at innumerable common points according to the law of avalanche, must be able to exercise on each other those definite and constant physico-chemical actions which we, with Tanzi, have admitted as the basis of consciousness. Thus relationships are established which are the counterpart of those which exist between the elementary actions determining the stimuli; relationships therefore adapted to symbolize external relationships. The process by which the

affections are influenced would be brought about, however, by the passage of stimuli into the interior of successive neurones, where the stimuli coming from outside would meet a modifying factor, which has no relation with external stimuli but rather with internal conditions peculiar to every organism and every cell.

One character possessed by all that goes to form intelligence is the tendency to stability. Inasmuch as the objective relationships are constant and the objective reality single, the process whereby consciousness undergoes improvement consists in the progressive acquisition of more exact symbolic reproductions of objective relationships in an invariable manner. The affective tone of the most simple sensations and perceptions is, on the contrary, variable; and as it represents a relationship of the external action with the state of the organism and its qualities and specific attitudes, it must vary with the difference in species, with the individual, and with the momentary conditions of the latter. Now the inter-neuronic connections have a tendency to be constant, because the stimuli reaching them possess constant characters; the cell body, however, has a particular physico-chemical constitution, obtained by adaptation during the course of the evolution of the species and reproduced hereditarily in the individual; this constitution has the specific representative characters of the animal species to which the individual belongs, and varies—within certain limits—according to the dynamic state and nutrition.

In the psychic evolution of the individual, intelligence is progressively developed by continued experience; the affective value of a psychic state, however, appears spontaneously at the first experience. Now it can be admitted with some probability that the acquisition of intelligence may be connected with the development which occurs in each individual under the exciting action of external stimuli, and that only its general lines are

prepared by heredity. The acquisition of affective tone, being in part independent of objective relationships, may be founded on some quality in the hereditary constitution of the nerve elements which are destined at a certain period of development to assume relationships with external stimuli. In other terms, while objective relationship is represented by central connections of terminals whose manner of association is influenced by the regular arrangement of the external stimuli, the subjective relationship—which is independent of the objective—is for the most part determined by a pure hereditary predisposition ready to come into play on the first stimulus.

As we know, the affective tone of sensations and states of consciousness in general depends in part also upon the dynamic state and nutrition of the centres, and this affective tone varies, although the objective significance of the impressions themselves remains unchanged. The state of nutrition, health, rest or fatigue, the slight acute or chronic intoxications whether endogenous or exogenous, influence the general state of affective tone—the mood—without causing objective appreciation to vary, at least in a direct manner. The pathology of the mind shows us slight states of depression and maniacal exaltation, depending upon a general organic cause, without any noteworthy intellectual disturbance. Now we know how the cell body represents the trophic centre *par excellence* of the neurone's mechanism, and on it the activity of the nervous process depends; we know also that rest and fatigue induce appreciable changes in it, and that intoxications and nutritional disturbances act first upon it and to a greater degree than on any other part of the neurone.

Strong excitation is unpleasant and even painful when it oversteps the limit of the nerve element's potentiality; now this functional potentiality appears to be closely related to special conditions of the cell body, in which

the most active phenomena of nutrition and metabolism occur.

Another argument in favour of our thesis is suggested by the great variance which exists between pure representations and affective states in the determination of actions. We know that comprehension determines action only in so far as it is accompanied by an affective tone: neutral impressions do not determine any action. It can be said that all conscious motor actions, will, and attention, are brought into play by representations only through the medium of the affective states accompanying them. The diverse reactions of the cell body, subjectively represented by the affective state, explain to us how stimuli may or may not determine action; in other words, how the affective state may remain in a condition of pure neutrality, determine a motor discharge, or an act of inhibition.

We actually find that in the very constitution of the neurone which represents a complete elementary nervous system, these relationships are clearly represented. External impressions reach the pericellular and peri-dendritic arborisations and there assume relationships corresponding with objective relationships, hence comprehension. The product received and elaborated by the dendrites reaches the cell body, where it produces a new effect, an internal modification, depending on its specific constitution and the state of nutrition; in this way the affective phenomenon arises. The different varieties of discharge which take place from the cell body through the axon depend upon the character of the intra-cellular elaboration.

The mechanism of *association* is the first of all the psychological processes to which anatomy has attributed special organs. For a long time, even before the existence of autonomous centres of association was maintained, it was usual to regard all the strands of the

encephalon connecting different points of the cortex as associative paths. It is true that the term associative when applied to the fasciculi and associative systems was always used strictly in its anatomical sense. In other organs also, fibres destined to unite centres or parts of centres of the same functional value were termed associative. Nevertheless it was very easy to pass from a purely anatomical to a psycho-physiological signification when treating of the cerebral cortex, which was recognised—though possibly in a general kind of way—as the organ of psychic activity.

According to modern data, as we have already seen, not only the anatomical but also the psychological conception of association must undergo restriction; it is to the associative function in this strict sense that particular centres and strands of subcortical fibres are assigned. With regard to these fibres which unite various parts of the cortex with each other, one must define even their signification. It is probable that many of them are devoted to another process, that of *apperception*.

Association and apperception have been considered from time to time as fundamental phenomena of such weight as to serve as the basis of interpretation of all psychic processes, and hence to be rivals, in a sense, for predominance in the mental functions. But as a matter of fact, as often happens, the antagonism is only apparent, and the doctrines are very easily reconcilable, seeing that their divergence only depends on a biassed consideration of the facts.

Associationism is a doctrine which attempts to reduce all psychic processes to the same plane. According to it the sensations and representations which form states of consciousness, accompanied by their particular affective tone, are joined together by an extensive network of associative relationships. The stimuli arriving *viâ* the senses exert their influence by means of bonds pre-ordained by heredity and by

antecedent experience, and promote nervous action without the intervention of any higher faculty. Even will results from the association of images.

The *doctrine of apperception,* stripped of all mysticism, is based upon the conception that there is a graduated series of organs and functions, which is equivalent to saying that there is a series of gradual syntheses which culminate in the highest psychic processes forming the personality; this takes place in some hypothetical supreme centre; moreover, it admits a mechanism of action and reaction developed among the centres of varying grade, with the result that the lower centres not only receive external stimuli passively, but their functions are regulated by the action of higher centres.

Now it must be admitted that this retrograde action of the higher on the lower syntheses, this what I might almost call a meeting of the personality with stimuli arriving from outside, was not unknown to the associationists, who in addition admitted the existence of an internal attention capable of bringing its influence to bear not only on sensorial processes but even on the course of ideas. This internal attention was thus comparable to simple external sensorial attention or, as it might be otherwise expressed, the adaptation of the sensorial apparatus. But let us point out that from the point of view of associationism it was not necessary to drag new and more or less mysterious forces into the argument; all was explained by the usual play of association.

We may lay aside this verbal controversy as one of no practical value. We are in a position to recognise that the process of perception is not purely passive, but that while new impressions arrive by the sensory paths to a centre, other currents move out from superior centres to meet them and exert an elective and co-ordinating action, favourable to some, unfavourable to others. This refluent action, which is initiated in the highest centres

in which we locate the highest syntheses and the sense of psychic personality, extends as far as the peripheral organs; and not only to the muscles which direct and adjust the sense organs, but even to the receptive nerve apparatus itself. The biological aim of this mechanism is naturally that of attention in general: to limit the field of consciousness and so to render it clearer; to effect a choice on external impressions and bring more into prominence those which are of greater importance to the organism under given circumstances. The reason why this choice should be exercised by central action is obvious; it is guided by antecedent experience and personal interest.

Anatomy appears to sanction these views. It has been known for a long time that from centres of all kinds, regulating stimuli pass out to the motor apparatus of the organs of sense; and so, for example, there are oculomotor centres not only in the nuclei of the brain stem, but also in the primary centres of vision; and among the cortical centres there are not only visual areas but also other zones destined for higher co-ordinations, which only stand in indirect relationship with vision. The minute anatomy of the nerve centres is adding some most important and unexpected knowledge at the present time: there are fibres in every section of a sensory path which run in the opposite direction to the principal current, and arise from cells situated in the same nuclei in which the afferent fibres terminate. Thus the optic thalamus is the source of centrifugal fibres which are directed towards the retina; and the visual cortex gives origin to fibres which run in the contrary direction to the optic radiations and end in the visual nuclei of the thalamus. Not only that, but between centre and centre of the cortex some direct fibres always run in each direction; these fibres can be considered ascending or descending respectively when they pass between centres of similar function, but of different grade; between centres

containing different images they exercise, on the one hand, an associative action, on the other, they are able to facilitate, raise, or inhibit certain associations in preference to others. And here is seen in the clearest way how association and apperception end often by becoming identical.

To all these hypotheses one can advance the simple criticism that they take us very far beyond any possibility of immediate verification either by observation or experiment. They therefore can appear as pure constructions of imagination incapable of being refuted or proved. I hold that hostility towards hypotheses of this nature may be damaging and unjustified. If an hypothesis starts from assured facts and involves no errors of reasoning it has as much value as the observations from which it takes origin. Criticism should not be directed towards the boldness of the conclusions arrived at, but to the exactness of the premises and the legitimacy of the deductions. If then diverse hypotheses starting from different fundamental data succeed in welding themselves consecutively into a perfectly coherent whole, not only does each emerge strengthened, but even the observations on which they are based acquire greater force than ever.

In certain fields of science it is necessary to base a strong line of argument on a few well-assured principles in order to reach remote conclusions which otherwise would be inaccessible. Where observation is more scrupulously accurate than in psychology, this method is adopted. The astronomer who calculates the velocity and direction of a star in motion on the basis of the displacement of the lines of its spectrum, and the physicist who, on the basis of the phenomenon of Newton's rings, calculates the microscopic variations in the distance between two glass surfaces imperfectly in contact, only form hypothetical deductions; nevertheless, these are

regarded as no less valid than direct observation. It is certainly very difficult to introduce the standard of experimental confirmation into the field of the relationship between the anatomical mechanism and psychic phenomena. But that is not to say that the hypotheses lose their value and utility; and demonstration can be considered as arrived at when the various particular hypotheses converge towards general principles which include all experience without contradiction.

If anatomy is going to be of assistance to psychiatry it must teach not only the normal mechanism of nervous and psychic organs, but the mechanism also of their functional alterations. Why, that is to say by what morbid process, are the psychic organs altered? And in what manner is organic action capable of determining disturbance of function?

From what we have already seen, the importance of determining the site of the morbid process is obvious. Although the connections between structure and function are very far from being defined in every particular, still they can co-operate to a certain extent in making clear the pathological mechanism; and at the same time the comparison of the exact localisation of a morbid process with disturbance of specific function can throw unhoped-for light on the physiology of specific organs. It was so with the pathology of speech; it preceded and created the physiology.

A morbid process can produce some conditions quite unattainable by experiment. We have seen how the cerebral cortex is composed not only of areas of different function, but also of an inextricable meshwork of differentiated elements contained in its thickness; strata, categories, groups of diverse elements, possessing strictly specific functions. Now if experiment attacks the cortical areas in a gross fashion, it certainly cannot blot out individual groups of elements. That may occur

however in pathological processes. Poisons especially are accustomed to exercise an elective action, to damage certain elements of the same genus, certain systems of fibres and cells of the same nature, while they leave the others uninjured. Naturally this elective action is admitted with certain restrictions; it is manifested best in the presence of toxic actions of a certain intensity, while those which are too energetic overflow and are generalised. The same holds good when the action is excessively prolonged. Experimental studies, especially those of Nissl, have demonstrated that subacute poisonings give the clearest results in localisation; the acute and chronic ones cause extremely diffuse lesions which often possess no characteristic features.

Delimitation of the lesion is a matter of primary importance. As it may be said there are not two microscopical elements in the brain having the same function, it is therefore necessary to know how far the lesion has extended before we can dare to draw a parallel between the disturbances and the lesions. On this point our knowledge is extremely incomplete. Up to the present the examinations of the cerebral cortex in mental disease have been performed more with the aim of recognising the quality, the nature of the lesions, in order to discover the pathogenetic process, than of exploring their precise extension.

Even in macroscopical lesions this estimation of their limits leaves much to be desired. But now experience has shown us that the *methodical and complete exploration of the encephalon* is always necessary; at least an examination which has not been carried out in serial sections is not held to be exhaustive or at all convincing.

The critical revision of the doctrine of the localisation of the lesion in aphasia, carried out by Marie through the accurate examination of old and new cases, has

demonstrated to what kind of gross errors a superficial and hasty macroscopical examination can lead. Only examination in serial sections can convey an exact idea of the extension of a focal lesion; and microscopical examination alone can teach us to what extent more diffuse lesions propagated by the interstitial tissues are added to the primary focus. Monakow rightly insists on the point that focal lesions provoke neuronic degenerations which are propagated to distant centres and are not visible to the naked eye, lesions of which nevertheless it is necessary to take count should one wish to establish an exact and complete connection between the anatomical lesion and the clinical symptoms. To-day the brains of aphasics, idiots, in a word, of all persons with diseases in which there are more or less apparent gross focal lesions, are beginning to be subjected to this complete examination which naturally costs time, work, and not a little money, but which is proving very instructive in every case. And the task of a similar examination with the aim of elucidating the microscopical condition of the nerve elements should not appear too great after the fine researches initiated by Kaes, Bielschowsky, Brodmann, Schaffer and others.

The *primary lesions* of nerve cells are most important in that they enable us to recognise not only the seat of the morbid processes, but their nature also. Their study is better carried out by means of experiments on animals than in the human cadaver. Such experiments have been carried out in great numbers and in the most varied manner during the last few years. One certainly cannot say that this study is exhausted, quite the reverse in fact, but from the accurate data in our possession we are already in a position to draw some general conclusions.

The lesions most readily recognised are not always the gravest. The nerve elements when so severely injured as to die, are rapidly destroyed by the neuroglia cells or

dissolved by chemical elements in the plasma, so that no trace of them remains. But from these lesions, though they are not readily demonstrable, symptoms can be better defined than when the pathological processes are actually in force, because in the latter case too often collateral effects on the sound elements are produced. Here naturally the functional disturbance always extends outside the actual field of the anatomical lesion, while, once a process is finished, the residual functional disturbance corresponds exactly to the anatomical lesion.

The minute study of the pathological processes which develop in the nerve cell was commenced little more than a decade ago as a result of Nissl's discovery of a special substance characteristic of the nerve cell. This substance is interspersed between the fibrils and shows very definite chemical affinities, especially for basic dyes, hence the great ease with which it stains electively. (Fig. 11A.) Nissl's substance shows characteristic arrangements according to the type of cell; its morphological disposition, its distribution in the cell body, and its quantity, are extremely easily influenced by the most varied morbid actions. At first it was hoped to place these modifications in relationship with functional disturbances, especially as the physiological alterations of cell activity, such as rest and fatigue, and notably states of functional exhaustion, sufficed to modify visibly the substance of Nissl. But from all the researches carried out it has been found that the modifications in Nissl's substance do not constitute an index of functional variations, but rather of modifications in the state of the nervous element's nutrition. These morphological modifications are compatible, within certain limits, with complete functional integrity even when they are quite obvious under the microscope. On the other hand, very extreme but rapid functional disturbances can occur, as, for example, in acute poisonings, without their presence or

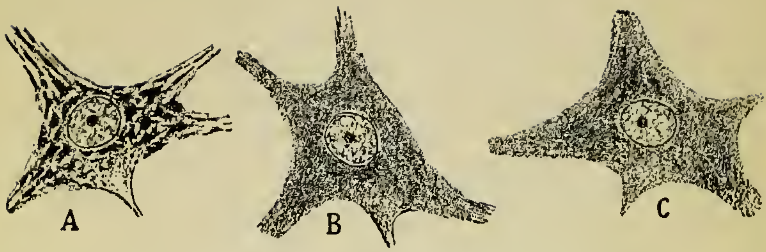

Figure 11.—A, normal cell from the anterior cornua of the spinal cord, stained by Nissl's method; B, cell of the same type from a case of experimental hyperpyrexia; C, cell from the anterior cornua of the lumbar enlargement of the spinal cord, examined six hours after the abdominal aorta had been occluded for half-an-hour.

course being registered by the slightest modification in Nissl's substance.

If a rabbit be exposed to a relatively high temperature, *hyperpyrexia* occurs which is fatal if prolonged for some hours or rapidly reaches the maximum of toleration. Examination of the nerve cells shows a quantitative diminution of the Nissl substance, which, further, is split up into very fine particles. (Fig. 11B.) In the higher degrees of hyperpyrexia symptoms of nervous prostration are not wanting; but when it is moderate there are no functional disturbances, although the anatomical change may be obvious. Further, should the animal be taken out from the hot-air chamber in time, it shortly recovers completely, while the lesion persists for some time. If the abdominal aorta of a rabbit be occluded, thus inducing an acute anæmia of the cord, paralysis of its entire hinder portion immediately ensues. On examining the cord at once no morphological lesion is observable. If the occlusion is maintained for one hour the paralysis becomes permanent; if only for thirty minutes the paralysis passes off some hours after the circulation has been re-established. In both cases the cells of the lumbar cord are seen to be altered, the blocks of Nissl substance are disintegrated. (Fig. 11C.) In the first case the cells degenerate and rapidly disappear, while in the second they gradually return to normal.

Quantitative and morphological modifications of Nissl's substance therefore are up to a certain point compatible with functional integrity.

But still they are of importance when we come to investigate which areas are responsible for nervous disturbance. The anatomical and chemical modifications, though simply the index of disturbance of the cell's nutrition and not of function either in intensity or extent, indicate exactly the elective seat of the morbid agent and probably therefore the centre from which dynamic disturbances radiate from

the injured elements to others absolutely uninjured. Especially in subacute and chronic processes, when, that is to say, the prolonged nutritive disturbance cannot fail to produce functional derangement and can even seriously endanger the vitality of the injured elements, it is evident that the seat of the nutritive disturbance coincides with that at which the noxious agent exhibits its greatest action, and therefore with the point of departure of the stimulus or with the seat of the paralysis.

The recent discovery of methods sufficiently adapted for demonstrating the *neurofibrils* rekindled hopes of our being able to find an anatomical change which would indicate the slightest functional disturbance. The neurofibrils, though not the only organ of nervous conduction as most think them to be, are structures differentiated from the protoplasm and set apart for the very rapid transmission of dynamic energy. Their functional importance then is very obvious.

Researches on the functional and pathological modifications of the neurofibrils, even though lately commenced, teach us already that whoever entertained hopes of discovering a simple and clear connection between functional disturbance and morphological alteration is again doomed to disappointment. This holds good even in experimental research. The neurofibrils do not show distinct modifications as a result of brief and not too great variations of functional states, variations which must be present in the ordinary processes of nervous action. Most obvious changes are seen, however, in severe pathological conditions, or when there are permanent physiological modifications. These are not the result of a transient disorder, but of a physiological variation of the general conditions of the organism. These changes have been found by Cajal and Tello in cold-blooded animals during hibernation;

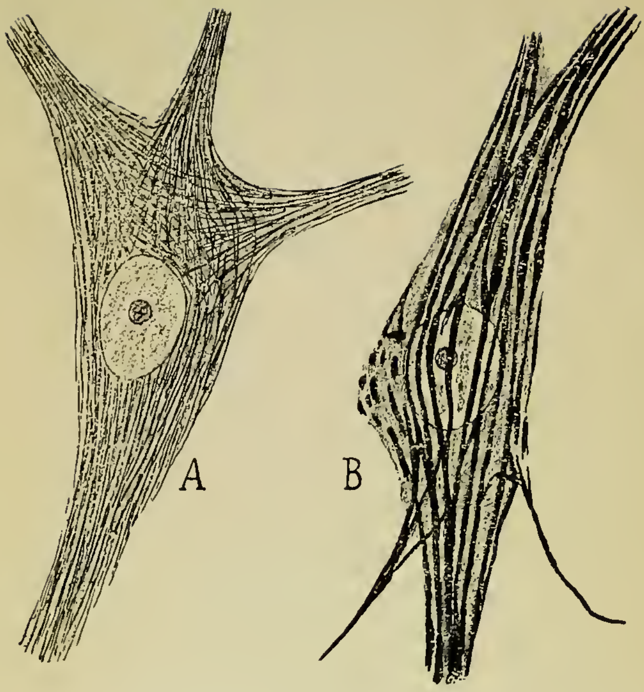

Figure 12.—Cells from the spinal cord of a lizard; A, in activity, at a temperature of 30°C; B, in a state of torpor, at a temperature of 12°C (after Cajal).

the neurofibrils, which during the wakeful period and in summer are very fine and countless, are transformed during the continued sleep into coarse cords few in number and containing all the disposable fibrillar substance. (Fig. 12.) Analogous alterations brought about by a combination of cold and prolonged fasting are met with in mammals (Donaggio), and in rabies and various other pathological conditions.

These changes are in all probability related to a profound change of nutrition rather than to alteration of function, although function can, and in certain cases must, be secondarily disturbed.

Physiological experiments conducted with quite a different aim also demonstrate that the conducting element must undergo very slight modifications, without any morphological change, as a result of the simple momentary passage of a nerve current. Here one must be dealing with chemical or physico-chemical processes to a great extent reversible, with changes which last a moment and are instantly repaired. Researches into nerve conduction have for a long time justified the belief in functional inexhaustibility of these organs, and in the possibility of function without appreciable chemical consumption. At present one is inclined to introduce some limitations to this view; it appears that organic consumption can occur, just as in the activity of every other tissue, but at any rate the chemical loss incurred in nervous conduction is extremely slight, and consequently it is possible that this function is accomplished without any morphological alteration.

However the case may be, whether the more prolonged disturbances of the conducting function alone induce changes in the fibres or are themselves an index of disordered nutrition, it is certain that these changes exist, and consequently must be taken carefully into account in investigating the seat and nature of the disturbances which form the substratum of mental

diseases. And the study of the changes in neurofibrils in the pathological processes found after experiment, and in the spontaneous lesions of disease, constitutes one of the most immediate tasks of histological research to-day.

Up to the present we have been considering only the cells and fibres, correctly termed the nervous elements proper because they are considered the organs of all nervous functional activity. But the centres also contain other tissues, some common to all the body viscera, such as the connective tissue and vessels, and one with specific characters, the *neuroglia.*

With regard to the vessels and the connective tissue which forms the meninges and the external sheaths of the vessels we will limit ourselves to saying that they have only an indirect connection with the functions of the encephalon, inasmuch as the former are distributors of the blood, and the latter act as protecting organs. From this standpoint their importance is very great, as is shown at once by the part they take in pathological processes when they are altered from any cause whatsoever. The topographical distribution of localised lesions depends on the distribution of the large and fine vessels; take, for example, the lesions from nutritional defect. The vessels and meninges take a most active part in all acute and chronic inflammatory processes; their modifications, the genesis of the elements to which they can give origin or permit to pass from the blood in pathological conditions and the pathological and physiological function of these elements constitute problems of the highest interest for cerebral pathology as for pathology in general. But we cannot linger over these rather too technical points. It is preferable to study the neuroglia, a tissue singular in this that it is only met with in the nerve centres.

The *neuroglia* is found in the interstices left between

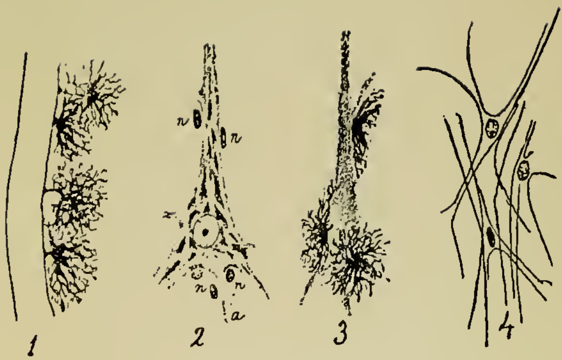

Figure 13.—Neuroglia elements; 1, neuroglia cells around a small vessel of the grey matter (Golgi's method); 2, nuclei of satellite neuroglia cells (n, n) around a cortical pyramidal cell; these are especially numerous around the point of origin of the axon a (Nissl's method); 3, the same cells by Golgi's method; 4, nuclei and fibres of neuroglia (Weigert's method).

the nervous elements proper. It is constituted of cellular elements provided with a scanty amount of protoplasm expanded into prolongations which very often are extensive and complicated, and of long independent fibres which traverse a large expanse of tissue. (Fig. 13.)

At first the tendency was to consider this tissue as an equivalent of connective tissue, and it attracted very little attention for the additional reason that little or nothing was known of the physiological importance of connective tissues generally; it was regarded merely as a support, a mechanical buffer, a protection for the other tissues; in fact little more than packing material. And up to a few years ago it is possible that even Weigert, an acute investigator, to whom we owe the most accurate conception of the neuroglia, attributed to this tissue the simple task of filling up the lacunæ left by the nerve elements, as much in normal as in pathological conditions when compensatory hypertrophy takes place.

Modern pathology, however, has revealed that connective tissues possess much more important functions than was previously imagined; in the chemical interchange of the normal organism, in defence against external and internal toxins and micro-organisms, the connective elements perform functions of the highest importance. Therefore the hypothesis that the rôle of the neuroglia is a passive one is evidently, even from simple analogy, defective.

The neuroglia shows in its distribution and in the morphology of its elements certain particulars worthy of attention and strongly suggesting that it fulfils more complex functions. It forms barriers near the investing membranes and the connective tissue septa, and envelops the blood vessels in a delicate sheath even to their smallest branches. (Fig. 13, 1.) Its elements in addition have totally different morphological characters according to the organ in which they are situated; they are different in the white and grey substances, and in

the latter they differ specifically organ for organ, layer by layer. Certain neuroglia cells are found closely applied to the nerve cells at certain points, others collect at the axon's cone of origin, where it is still uncovered by its myelin sheath. (Fig. 13, 2 & 3.) These therefore are called satellite cells. From the last-mentioned facts especially, Cajal thought the neuroglia possessed an insulating function, and that it was interposed in the series of neuronic links at the points where the passage of currents from one neurone to another were not intended to take place. This hypothesis of Cajal, founded on numerous morphological facts, is no doubt highly probable, but the possession of an insulating function does not exclude the possibility of others perhaps even of a more important nature.

Pathological facts advance ample testimony in favour of this view. The neuroglia always reaches the maximum of its activity in morbid processes. Even in simple acute poisoning the neuroglial protoplasm is swollen in a special manner, and there are obvious morphological changes in the nucleus. In subacute and chronic processes, especially if accompanied by destruction of the nerve elements, the neuroglia cells undergo incredible transformations; they multiply, increase to a huge size, acquire the power of migration, of gathering into their protoplasm and of destroying the remains of cells, fibres and blood corpuscles; they form cicatrices composed of very fine bunches of fibres. The polymorphism of pathological neuroglia cells is surprising; every day the study of these elements brings to light new forms and arrangements.

All this demonstrates that the neuroglia is most sensitive to the chemical disturbances which occur in nerve tissue, and that it counteracts them by energetic reparative action, by destroying the residua of elements which would contaminate the region involved. If this is its function in pathological conditions, it probably has

other analogous functions under normal conditions, when its elements are apparently in a state of repose.

I hold it as probable that the neuroglia normally possesses *antitoxic* functions which are exercised in two different directions: against the blood and against the nerve elements. The central nervous system is very highly sensitive to the presence of poisons, and it often reacts violently to the introduction of incredibly small doses of toxin into the organism. Hence there is no reason for surprise if it is normally defended against the toxins which circulate in the blood for physiological purposes. The nutritive plasma, before reaching the nerve cells, elements which so readily react to stimuli, probably therefore undergoes a special filtration during the passage through the sheath of neuroglia surrounding all the vessels.

We know of more than one analogous mechanism of defence against poisons in the body; the liver is a barrier to many toxins absorbed from the intestine; the white blood corpuscles neutralise many poisons which succeed in introducing themselves into the blood stream. A barrier to defend the nervous elements is certainly not unnecessary, for the important reason that during the ordinary physiological processes the blood plasma is continually invaded by poisons of every kind and from every source; waste products of cell work, internal glandular secretions, specific substances which are continually employed in the chemistry of metabolism, but which act as poisons should their quantity become excessive.

It is especially against these physiological toxins of the organism that the neuroglial filter must be opposed; but that does not exclude the possibility that it sometimes acts against exogenous poisons, not habitually present in the body, against which a true and appropriate biological process of adaption cannot be invoked. It is certain that some poisons produce a relatively mild effect when

introduced into the circulation, while immensely smaller doses introduced directly into the nerve tissue give rise to the most profound functional disorders.

The neuroglia probably exercises an analogous antitoxic function against the katabolic products of nervous activity. It is known that in the central nervous system there are no special lymphatic vessels to drain away the regressive products; and therefore the contaminated plasma must always traverse more or less extensive spaces before reaching the lymphatic sheaths of the vessels, and so come into contact with many other nerve elements. It is for this reason perhaps that the necessity arises for a biological destruction of these products. This would be accomplished *in situ* by the neuroglial elements, in particular by those which are closely applied to the cell and insinuate themselves into all the little hollows of the cell body; they would thus be in the most advantageous position for acting on these substances and rendering them innocuous. (Fig. 13, 2 & 3.)

That the neuroglia must play a most important part in the chemical process of nerve tissue metabolism can be deduced also from the effects caused by its alteration. When, from causes which are at present unknown, the neuroglia forms tumours which are sometimes rich in elements of huge size and absolutely different in appearance from the normal, its chemical activity is perverted, and instead of exercising an antitoxic action it gives rise to local intoxications due to the production of abnormal substances. In fact such tumours, although they may induce no symptoms of destruction or compression on account of their small size, yet are very often the cause of grave irritative and paralytic phenomena, and sometimes occasion death quite unexpectedly.

This view that the neuroglia exerts an antitoxic influence is naturally purely hypothetical, a hypothesis nevertheless which is supported by numerous and sufficiently significant facts of diverse nature. It is

certainly desirable that researches should be carried out directed towards controlling this view, and establishing the normal function of a tissue which takes so active and direct a part in all the pathological processes of the brain.

Psychiatry therefore puts to anatomy a double series of problems. On the one hand, it requires the normal morphological data without which neither the normal nor the pathological mechanism of psychic phenomena can be made clear; on the other hand, it demands objective demonstration of the changes in nutrition which affect the nerve elements, and which depend on causes absolutely analogous to those usually injurious to the functional and anatomical integrity of every other organ of the body. There are immense gaps in our knowledge, but the line of research is clearly indicated, and there are offered to the activity of workers a thousand ideas on which to base original investigation.

IV. Problems in Pathogenesis

The pathogenesis of psychic disturbances must be discussed from two points of view. Firstly it has relation to *the objective determinism of disturbances of the consciousness according to the laws of psycho-physical parallelism;* it is concerned therefore with the modification of cerebral processes in disease, with the connection existing between psychopathic phenomena and functional disorders, and with the anatomical lesions of the cortical nerve elements. Secondly it is concerned with *the genesis of cerebral lesions* and consequently with all the objective mechanism, both cerebral and extra-cerebral, which connects these lesions with the morbid action in a more or less direct manner.

On account of the close connection existing between the second question and the study of causes, we shall discuss it along with the etiological problems. For the present we must endeavour, as far as possible, to collate the more general data of psycho-pathology with those of normal and pathological anatomy. With those subjects so incomplete we cannot hope to construct a thorough and solid scheme which will explain everything, and much will be attained if we succeed in establishing the main lines of connection between the facts derived from the above sources. Nevertheless the general relationships which we are able to bring together, even although of a hypothetical nature, will be valuable in giving us some synthetical mental survey, will help us to understand the difficulties which arise, the gaps in our knowledge, and will suggest to us the direction which research must pursue if it would fill them.

As we have already seen from psychology, we are justified in creating a fundamental distinction between *primary* and *secondary* psychic disturbances. No matter how difficult it may be to separate with precision what is a secondary effect of an antecedent psychic disturbance from what is a direct expression of the abnormal organic process developed in the brain, it is certain that we can imagine a whole series of connections between the pathological alterations of consciousness, of which some would be only a necessary consequence of others.

Anatomy and physiology warrant the principle of the localisation and specificity of function; they teach us further that the specific functional value of nervous organs, and therefore the localisation of function, will be established by microscopical research. Pathological anatomy shows us lesions, sometimes circumscribed, sometimes extensive, now systematic, now diffuse, but to all of these the concept of localisation is applicable.

Now it is necessary to see in what way these lesions may disturb, primarily, the functional power of the special systems of the brain, and how, as an echo of the induced primary disturbance, there may arise a whole sequence of other disturbances which differ from the first inasmuch as they are the physiological effects of normal association, brought into play however by pathological causes.

It is not to be presumed that the primary lesion which determines the psycho-pathic state is always to be found in the brain itself. The brain by means of its nerves is in direct or indirect dynamic connection with all the body organs. Hence it is possible that a brain intrinsically sound may show some pathological manifestations for the sole reason that the stimuli reaching it are not normal; these may be proceeding from sensory organs or from other parts of the body altered in structure or function. To a mechanism such as this

may be attributed for example, the onset of psychoses from neuralgia, blindness, lesions of the peripheral auditory apparatus, et cetera. But it now appears to be demonstrated that should the cerebro-psychic constitution be really normal then such disturbances arise with difficulty, or at any rate pass away on cessation of the cause. Where the disturbances are of grave proportions or persist, there is always some deficiency in the central organs, some latent anomaly, some slowly acquired weakness, and in these circumstances the peripheral stimulus only elicits the latent defect.

Nevertheless that does not diminish the pathogenetic importance of abnormal peripheral stimuli. When a cerebral lesion actually exists, it does not necessarily follow that all the psychic disturbances are due to it. We can find examples of noxious actions which have injured other organs besides the brain, in which case it is not legitimate to attribute to the brain alone what is an effect of concomitant lesions of peripheral organs. It is also possible that a primary cerebral lesion induces anatomical alterations or functional disturbances in peripheral organs, which in their turn forward abnormal stimuli to the brain. In every case, therefore, especially when dealing with sensorial functions and sensibility in general, it is always an open question whether the psychic disturbance is an effect of cerebral or extra-cerebral lesions.

The brain can be influenced by actions going on in the viscera in quite another way, viz.: through the circulation, rather than by the dynamic path. An anatomical lesion or a functional disturbance of any organ whatsoever is capable of changing metabolism, contaminating the blood with abnormal products, and in this way becoming prejudicial to the chemical exchange and nutrition of the nerve elements. But it is evident that in this case there is a direct action on the cerebral elements as if a morbid agent was

carried directly from the exterior to the brain. Direct action on the brain may be coarse and extensive, such as that of a tumour or large hæmorrhage, or fine and diffuse, such as occurs from the action of a toxin. In the latter case all the elements come into contact with the pathogenic agent, but there are always affinities, special chemical predilections, varying from one case to another, so that only certain elements are injured. We have already noted that this affinity and the systemic lesion which is its result are not absolutely limited, and that the excessive intensity or duration of the stimulus generally causes the lesion to spread. It should be added that most probably the area affected by simple functional disturbances from toxic action is always far greater than that in which nutritional alterations take place. The latter sooner or later give rise to reparable or irreparable anatomical lesions.

Perhaps the pathogenetic mechanism is never so simple as the above. When there are coarse and circumscribed anatomical lesions, indirect effects come into play which may sometimes assume by far the greatest prominence in the symptomatology, *e.g.*, at one time there may be diffusion of chemical stimuli from the altered tissue, at another, direct action on the vessels and as a sequel general disturbance of the cerebral circulation; now an increase of intracranial pressure conducive to the same effect, now a combination of all these accessory causes. The diffuse effects of these actions naturally approximate to those of toxic action, because if they are not extremely grave all the nervous elements are not uniformly affected.

There are also certain diffuse lesions which advance without showing any special preference for systems of cells or fibres: a noxious action can start diffusely from the vessels, the meninges, or the neuroglia. If these tissues are altered primarily the nerve elements are injured secondarily, and are attacked by the pathogenetic

agent solely on account of their contiguity. The result is that their lesion and the ensuing functional disturbance have no systemic and elective character.

Whatever be the mode of action of the morbid cause and whatever the distribution of its effects, the consequences to the nerve elements may either be purely dynamic or anatomical: obviously both may be combined. The anatomical effects, the result of injuries or disturbed nutrition, consist in reactive and in degenerative processes, which may pass on to complete destruction. The functional effects cannot consist in anything but the evocation of excitability or in its depression up to the point of complete paralysis; the latter may be a transitory effect of a modification still capable of recovery, or the permanent effect of destruction. We are bound to consider here what the psychic effects are in general, direct or indirect, primary or secondary, of such elementary disturbances.

Let us examine first of all the negative effects, the *phenomena of deficiency* which follow simple destruction of organs. There is on the one hand a *hiatus* in the psychic contents, on the other *dissociation* of the functions still active. This dissociation shows itself in two ways: as a pure *associative defect,* due to the want of certain images and of certain elements of the psychic patrimony in general; and as an *apperceptive defect,* inasmuch as that action is lacking—sometimes facilitating, sometimes inhibiting—which the destroyed images ought to exert on other images or other perceptions as they appear.

The more typical and better known disturbances of this kind are observed in the various forms of aphasia, a disease due to total or partial destruction of the centre for comprehension of language, in which the auditory verbal images are situated (the centre of Wernicke), or of the centre of motor verbal expression in which the articulatory images are placed (the centre of Broca).

With a lesion of the centre for heard speech the word, though heard, is no longer understood: there is the so-called word deafness. If the articulatory centre is injured the capacity for pronouncing the word is lost, although the organs of phonation may not be paralysed: there is motor aphasia. In the so-called amnesic aphasia, as we saw, the dissociative effects of the lesion predominate, and render the spontaneous evocation of the verbal images impossible.

There may also be dissociation of images without destruction or lesion of the centres in which these images are situated, occurring simply through injury of a strand of subcortical fibres. The only outstanding example of this kind is found in that rare affection termed pure alexia. This is characterised by an inability to read, notwithstanding that the visual cortical image can be formed, and depends on the interruption of paths which unite the primary visual centre with that still imperfectly localised centre in which the images of letters are transformed into true visual verbal images, and acquire their symbolic signification by association.

The influence which the circumscribed lesion of a centre can have on the function of other distant centres is clearly demonstrated by certain characteristic disturbances, apart from the articulatory incapacity, observed in cases of motor aphasia. In individuals so affected the auditory word centre is uninjured, so that they are in a position to understand and execute an order suggested aloud: but with some limitation. If the order is simple and its execution is to follow immediately, all goes well: if, however, it is somewhat complex, and especially if it has to be executed after an interval of time, either it is done badly or not at all. Disturbances of this nature, which vary considerably in individual cases, have led Marie to think that in every aphasic, even if the presumed centres of heard words are uninjured, a more or less grave disturbance of the comprehension

of heard language always exists; and that is why a material diminution of the intellectual capacity is always present. These facts are even sufficient to make Marie doubt the double localisation, auditory and motor, of speech.

Making every allowance for the modifications which our conceptions regarding the localisation of the speech centres may ultimately undergo, when that clinical and anatomo-pathological revision of which Marie has demonstrated the necessity has been made, we may note that the above mentioned phenomenon is very well explained even if we accept as exact the current conception of the localisation of auditory images in Wernicke's centre, and the articulatory in Broca's centre. It is sufficient to admit that between these centres there are neuronic connections directed in two ways; and that such is the case is very far from improbable. In interpreting aphasic disturbances we usually take count only of the associative current passing from the auditory to the articulatory centre. The auditory centre thus exercises a continual regulating action on the articulatory centre; and by its suppression all the disorders of spoken language which are capable of being produced by an isolated lesion of the auditory word centre are explained. But one is apt to ignore the consequences which necessarily follow suppression of the current passing in the opposite direction, which goes that is to say from the articulatory centre to that of heard language.

We have already seen that the mnemonic images, the representations of a definite sensorial order, operate in a retrograde way upon perception in the same field, determining internal attention (apperception) which selects some of the stimuli and suppresses others, so bringing together those suitable for the immediate purpose. Analogous relationships must also exist between centres which are not of the same order but are bound

by constant associations, such as the motor verbal and auditory verbal centres. Now it is natural that the sudden lack of the retrograde coefficient which passes from the motor speech centre to the auditory should render the collection of new auditory perceptions more uncertain, and that this defect comes into particular evidence if the verbal series to be brought together are complex.

The explanation of the loss of memories for acts to be performed at a stated time and in a given order is even clearer. It is a general law of memory that the more numerous and intimate the associative bonds, the easier is evocation and the firmer the fixation of records. It is easier to memorise poetry than prose; to recall to memory a sensible sentence is easy, while it is most difficult to retain a senseless series of syllables. Consequently when the motor verbal images are wanting through destruction of their centre, it is quite natural that the fixation and evocation of verbal auditory images should be rendered more difficult, although they can still be received and understood. The intellectual disturbance associated with motor aphasia is reduced then to *a simple diminution of the capacity of grasping verbal auditory impressions* and a considerable loss of the faculty of fixing them in the memory and of evoking them.

Up to the present we have taken into consideration the coarse but circumscribed lesions of the cerebral cortex which destroy a given portion of it without injuring other parts. But there are minute and destructive lesions which can only be demonstrated by microscopical examination. These are characteristic of the processes which lead to dementia.

It is not easy to imagine that purely destructive lesions alone are responsible for the symptoms in these cases. In two familiar examples of diffuse lesion of the

cerebral cortex, senile dementia and general paralysis of the insane, the nerve elements are injured in an almost entirely unsystematic manner. The lesions undoubtedly predominate in certain elements, but are not elective, and the active changes seen in the interstitial tissue and vessels help not a little to deprive the anatomical appearances of all systemic character. But in addition—and it matters not at what phase we find the process—we can never say the symptoms are simply those of defect determined by destruction or damage of the nerve elements. It is especially difficult to weigh cause and effect within such narrow limits in progressive paralysis, which has a more turbulent course and in which grave nutritive and toxic disturbances, giving rise to irritation, are seen from time to time. There are also cases of senile dementia which pursue a wild and disorderly course. In this disease, however, it is a much more common experience—during certain periods of remission—to find that the cerebral disturbances can be regarded as almost exclusively those of defect. In such cases, and also in general paralysis of exceptionally slow and regular course, it is found that the destruction is nonsystemic notwithstanding the fact that the disturbances show a certain regularity of progress. The readiness with which new impressions are grasped is sometimes enormously diminished, as is also the capacity of fixing new records; memory gradually crumbles away, the more recent images going before the older and more habitual which are more resistant.

As we have seen, all the above can be explained if it is admitted that even the simplest images have an extensive localisation in the cortex, and that the firmer memories are stored up in more extensive and dense cortical networks, which naturally are relatively less prone to damage by diffuse lesions. Disturbances of attention, diminution of the capacity for grasping and fixing

memories, are the result not only of direct destructive action on the elements destined to receive the individual specific images, but also the effect of the general associative and apperceptive disturbance which necessarily follows the progressive rarification of the connections between nerve elements, not only of those near each other but also of those far apart.

In contradistinction to these types of dementia, the result of nonsystemic and diffuse lesions which manifest themselves clinically as defects of perception, attention, memory, and all the other faculties dependent upon or connected with association, there are other forms whose characteristic is weakness of certain special psychic activities while the rest remain sound or nearly so. The latter are most probably due to microscopical lesions of the cortex, certainly affecting large zones but limited to definite strata or to single categories of elements which constitute systems in themselves. In support of this view anatomical data are as yet very scanty, but some clinical facts hold out hopes that a more systematic and thorough investigation will lead to interesting results.

There is a morbid syndrome which includes many and varied symptoms, and is characterised by forms of dementia, which at first sight appear to be systematic to a certain extent. We refer to the so-called *dementia præcox*. As we shall see later, this disease includes many very different clinical types: the dementia is more or less rapid, more or less accentuated, and involves the mental functions to a greater or less extent. But, speaking generally, if certain cases are excepted in which the dementia is very rapid and goes on to almost complete dissolution of intelligence in all its forms, there is some elective limitation of the process. In the milder cases especially, and in those arrested during a remission after the disease has lasted for some time, the following facts become more evident, viz., that the

ideative processes generally, memory, perception and movement are intact, and that it is volition, together with the affective states more intimately connected with it, which is completely broken down. But singular differences in conduct and voluntary movement are noted in the various cases. Sometimes in inveterate cases, lasting twenty or more years, it is seen that behaviour is orderly; the habits of the patient, though limited and monotonous, are correct, while speech shows profound alterations: articulation may be perfect, but the subject matter is incoherent and nonsensical. In other cases the verbal expression is correct and to the point, but the attitudes, the movements, and the gait show bizarre stereotyped characters, which give a personal and grotesque stamp to any action whatsoever on the part of the patient. Now it is precisely these cases, provided they were subjected to an exhaustive psychological examination during life and to a complete anatomical examination after death, which would be very interesting in the study of the diffuse destructive but systematic lesions of the cortex. And this is a task which will demand great patience and much time, but it will possibly give results of the highest interest for physio-psychology, and may furnish valuable hints regarding the function of the most delicate anatomical systems.

When a morbid action does not destroy the elements on which it acts but stimulates them, what effects are induced in the field of consciousness? We know that stimuli of diverse nature, mechanical, chemical, or electrical, acting on a sensory path, can induce nervous currents in the fibres. These currents produce a subjective effect absolutely identical with that which follows stimulation of the corresponding peripheral sense organ, possibly because they possess specific characters of their own, or because they assume

them on reaching the centres in which the nerves terminate. An analogous effect is produced if the motor centres are stimulated, and a muscular contraction results. Therefore the conclusion seems to be that, speaking generally, every nervous organ excited directly can react according to its specific properties. Consequently it is admitted that a stimulus acting on the sensorial zones of the cortex may be able to provoke hallucinations in the same way that a stimulus of the motor zone induces convulsions.

Knowing what we do of recent data of cerebral anatomy and physiology, we must limit the scope of these hypotheses to a great extent, especially when we would apply them to the explanation of the origin of morbid mental conditions. We have seen that anatomy now shows us in the most certain manner that in the elaboration of the simplest sensation thousands of nerve elements must take part, and that each neurone can participate in the elaboration of innumerably different elementary phenomena. So that the physiological processes corresponding to single perceptions, single ideas, even of the simplest nature, must be localised in nervous networks which are very extensive and closely interlaced with those which remain inactive. That being granted, the problem which at once arises is how a coarse stimulus, not advancing by the normal nervous paths but attacking collections of cells and fibres indiscriminately through an extra-associative path, can produce that very delicate complex of specific and co-ordinated processes which constitutes a perception, an image.

When a cortical motor centre is excited experimentally the excitation produces an objective effect, a movement. But can we compare this movement provoked by the external stimulus to a kind of voluntary act? By no means; the movement which we see is the resultant of a thousand excitations and of a thousand simultaneous stimulations and inhibitions, and psychologically is a

purposeless movement. On stimulating a sensorial centre perhaps an analogous effect may be produced, but this certainly will not be comparable to a definite sensorial image.

Let us recall the fact that the fundamental character of the phenomenon of consciousness is distinction; we are conscious inasmuch as we distinguish, and our consciousness becomes more vivid the more clearly we distinguish.

Distinction is the clearer the smaller the number of objects under comparison, and the process of attention which renders consciousness clearer and more active attains this result by restricting the field of consciousness and by reducing the number of objects to be compared. Distinction is certainly impossible if a stimulus excites all the elements of a cortical zone in a very diffuse manner. It is true that in certain cases of coarse cortical stimulation, such as produce epileptic attacks, we have at the beginning the phenomenon termed an aura, consisting in sensations of varying kind situated for the most part in the region which will be alone convulsed, or be affected first, or suffer more than any other. But the sensations which constitute the aura are often the effect of a motor or vasomotor change in the peripheral organ in which they are started; when they are truly of central origin they can, as we shall see, be provoked indirectly. It is to be noted, however, that the aura is manifested only so long as the stimulus is circumscribed and slight; when the stimulation is greater and the convulsions commence, the activity of the innumerable neurones involved does not result in a highly complex state of consciousness, but in profound unconsciousness.

From the above then we can conclude that a stimulus acting directly upon the cortical nerve cells through an extra-associative path, has less power of determining states of consciousness the stronger and more diffuse it is; in any case it is incapable of directly awakening a

sensorial or representative complex image, because these images require the simultaneous and co-ordinated activity of innumerable elements which are scattered throughout wide cortical territories and are mixed with a great number of other elements which must remain inactive.

Nevertheless we cannot exclude the possibility that consciousness is influenced by extra-associative stimulation of the nerve centres. The effect which is not obtained by direct stimulation of a centre may occur indirectly by stimulation of other centres. For example, a stimulus acting diffusely upon a given centre will, on leaving the point of excitation, spread to other centres and influence them through the normal paths of inter-cortical association; and so the stimulus is no longer extra-associative. By the same complex of processes of excitation and inhibition, which plays so great a part in the regulation of association generally, a coarse stimulus, which does not awaken consciousness in the organs in which it arises, can undergo a process of selection on being transmitted to other centres where its action is partly inhibited and partly facilitated, and so may come by degrees to be progressively more capable of being incorporated in associative processes.

Still in accepting the above we must make some reservations with regard to the extra-associative action of coarse stimuli on centres and nerve paths. Very often these stimuli are so feeble that they do not produce sufficient nervous excitement to awaken consciousness. Their action may be limited to the production of a mere diffuse increase of excitability.

In studying a case of tumour of a motor centre and its resultant convulsive phenomena in the musculature corresponding to the area involved, we are apt to think that the tumour exerts its action directly, in the same way as mechanical, electrical, or chemical stimuli act in physiological experiments on the cerebrum. But the process is not so simple. Weak stimuli which do not

give rise to immediate reaction, can, however, produce cumulative effects, and periodically determine the explosion of convulsive phenomena. During the period in which the action of the morbid stimuli is not manifest, it is clear that a simple increase of excitability must be produced in the affected part and in others connected with it, so that the stimuli arriving there by the normal paths and being added to the first, can act as the exciting cause of the discharge. It is precisely in this way that general or localised convulsive attacks occur even when the stimulus is situated outside the motor zone in which the convulsion starts.

This, therefore, is another way in which coarse stimuli must frequently act. And as the morbid action comes into play gradually and slowly as a general rule, a long period must elapse during which its effect consists only in the determination of a local hyperexcitability to stimuli propagated along the normal path. In this case the effects produced by the diffuse hyperexcitability resemble those usually attributed to the action of chemical substances.

Diffuse *chemical action* on the brain, which in mental disease is determined by a great number of exogenous and endogenous poisons, modifies the conditions of excitability. It may elevate or depress it. On this point experimental data have shown us already that extremely different actions may take place which depend on the power of election which certain substances show for certain anatomical systems, or for entire categories of systems, and on the different influence, exciting, depressing, or paralysing, which the same substance is able to exert according to the dose and the duration of the action; so that the effects of depression and stimulation, simultaneous or successive in diverse systems, can be combined in a thousand ways. On this question we

must limit ourselves to the consideration of the simplest elementary effects, depression and excitement.

It is obvious that the effect of *depressing actions* must be analogous to that of destruction, but of less degree. The maximal point of depressing action, functional paralysis, is, so far as function is concerned, equivalent to paralysis from destruction.

We very rarely see as a result of toxic actions of a depressing nature, those local and complete paralyses associated with functional integrity of the uninjured organs which are characteristic of destructive lesions. There are instances of the most accentuated elective action. A typical example of this is seen in chronic uræmia in which a definite group of aphasic symptoms is determined by the toxin exerting its maximal effect locally; but in these cases there is always a slight reaction of the entire cortex and of all the psychic functions. Certain functions are injured more than others by toxic and severe nutritive disturbances, such as those induced by myxœdematous intoxication, or by cerebral compression, but the general effects are always more prominent. Consequently it is only in exceptional cases that we can expect to find a loss of some categories of images—possibly temporary, but limited and total—from a generalised toxic cause. As a rule only general disturbances are found, though these are not equally accentuated in all the various functions.

It is only natural that the functions, for which a more complex co-operation of units is necessary, must react to the effects of a general depressing action more than other simpler ones; therefore the highest functions are the first to become weak. The processes which are determined directly by sensorial stimuli are therefore more advantageously situated in comparison with others produced by internal stimulation through associative paths. This constitutes another reason why the perception of objects may be less disturbed than

the association of ideas, and especially the elaboration of complex processes of reasoning. But perception itself feels the damaging effects of slowing and simplification of associative processes: weakening of sensorial attention and of apperception properly so-called occurs; the external impressions no longer undergo any process of selection, any reinforcement or any inhibition on the part of the associative centres, and consequently they are received passively without being impressed on the memory or without exciting any interest. Therefore from the general depressing action there results weakening of association, of reasoning, of elaboration of motives, of will power, of the capacity for grasping, retaining and elaborating the external impressions, and of taking an interest in external affairs.

Not less injurious to the psychic functions is a *diffuse increase of excitability*, which, if of moderate degree, may appear at first sight an element favourable to function.

At this point it is necessary to consider some data in normal psychology, which we have already indicated in the preceding chapters. We noted that the associative mechanism, in order to carry out its biological aim, must be multiple, not rigid but plastic; to each representation numerous associative paths must be thrown open capable of awakening many others, which represent so many impressions previously received and stored in the brain. But, on the other hand, there is a biological and psychological law which contrasts with the above and precludes its acceptance in an absolute sense. The organism reacting to its surroundings is often engaged in some action which commands its sole attention; this is more especially the case when the action is complex. Psychic acts, the product of the co-ordination of many elements, can only develop in the same cerebral network one at a time and in regular sequence, because with any other arrangement there would be a risk of disturbing

their order, and no useful result would be attained. Therefore another series of stimuli comes into play which inhibits the associative stimuli—whose natural tendency is to provoke numerous associations—and restrains the process in order that each association may exhaust its effect before another is formed. Not only that, but an analogous co-ordinating action whose object it is to facilitate some associations and inhibit others, is developed between psychic processes of different grade, so that a representation which is occupying the field of consciousness tends to exclude not only other representations but also actual perceptions which would disturb it and cause it to vanish. In a word all somatic and psychic activities must always be concentrated towards a definite purpose which is that of serving what is of the greatest interest at the time being; and thus the activities are not squandered in incoherent action.

From this it is seen how delicate and complex the mechanism of association is, and it is easily understood how the process must be best accomplished by a state of excitability of the nervous elements which not only permits of association but also of inhibition. Below this standard we find torpor, slowness, indifference, tendency to psychic inertia, and arrest of the flow of ideas; above it, there are multiple and incoordinate excitement, flight of ideas, incapacity to form a long and coherent series of thoughts, incapacity for reflecting on the consequences of an act, for fixing attention on any object whatsoever, absent-mindedness, and in extreme degrees chaotic confusion of ideas and even unconsciousness. That unconsciousness may be produced will possibly seem paradoxical, but we know that psychic processes tend towards this when they become jumbled together as a result of an excess of simultaneous stimuli.

It is very probable that other disturbances of the

utmost importance may be caused by diffuse chemical stimuli; we refer to those of the *affections*. Not that there is any reason to think that this is the sole genetic mechanism of derangements of the affections, and that these cannot arise secondarily to other psychic disturbances, for example those of ideation, through the usual associative mechanism. But clinical experience teaches us that, more frequently, disturbances of the affective states are absolutely spontaneous, and that it is rather they, as we shall see, which influence ideation.

If we take into consideration all that has been said regarding the normal mechanism of the affections, and the connection which this psychic function has with the nutritive and dynamic states of the organism generally and of the brain in particular, the simplest explanation of its derangement is that it is a primary disorder due to diffuse chemical influences which, according to the hypothesis previously mentioned, would act upon the cell bodies or on particular substances contained in them.

To the above arguments we will also add this, that disturbances of the affective equilibrium form one of the factors by means of which a person passes imperceptibly from the normal to insanity, and that even normal individuals often show spontaneously affective oscillations which even ordinary untrained experience associates with states of auto-intoxication. We will add further, there is no disturbance of co-ordination nor any process in which inter-neuronic connections are separated, which can blot out or necessarily weaken the affective states. In progressive paralysis and in other diseases in which intelligence deteriorates *pari passu* with the damage of inter-neuronic connections, the affective states can be preserved in their full vigour even when the brain is considerably disorganised by the destructive process.

Up to this point we have reviewed the fundamental forms of disturbances which are determined by direct alterations of the most varied kind. But we have not considered amongst these any very important forms which occupy a prominent position in the symptomatology of mental diseases, *e.g.*, hallucinations, delusions, and fixed ideas. With regard to hallucinations, we have already recognised explicitly the impossibility of their primary derivation from a stimulus acting directly on the sensorial centres. This seems to indicate that, in all probability, all these forms of mental disturbance are of secondary origin, arising, that is to say, as the result of other disturbances.

The relation which exists between *hallucinations* and delusional ideas has been known for a considerable period of time : these relations have served as a guide to the foundation of the doctrine of hallucinations. This relationship comes out more strongly in those more complex and co-ordinated forms of hallucinations which affect different sensorial spheres simultaneously, and which for that reason can be attributed less than ever to a coarse and direct stimulation of the corresponding cortical regions.

If it is recognised as impossible that coarse and direct stimuli induce definite hallucinations; if the strong probability of the existence of special centres for representations is granted, then it is possible to interpret the hallucinations as a product of an indirect excitation of the sensorial centre, prompted by and under the coordinating action of the representative centres. This is precisely the hypothesis put forward by Tanzi.

The normal relationship which exists between perceptions and representations can be inverted to a certain extent by pathological conditions. Normally there is a continual passage of stimuli from the perceptive to the representative centres; when an actual image is being formed in the perceptive centres, these forward to

the representative centres a co-ordinated nervous process which must leave its imprint there—the mnemonic trace of the corresponding image. The representative centre forwards to the perceptive centre—in virtue of its own functional activity and by means of special fibres—particular exciting and depressing influences which, as we have seen, possess the capacity of giving opportune prominence to the images which are of special momentary interest. This modifying retrograde action is normally only of secondary importance, and although it regulates the influx of the external impressions, it neither distorts, falsifies, nor creates them. But in pathological conditions, which raise the functional activity of these retrograde fibres or of the representative centres in which they originate, stimuli can pass backwards and awaken images in the perceptive centres, which are absolutely similar to those provoked by external objects: hallucinatory images.

Nevertheless there are hallucinations which do not show any clear relationship with the course of ideation. In the acute and sub-acute intoxications especially, in which there is a great number of sensorial errors accompanied by confusion of ideas and by exalted and incoherent motor excitement—such as occur in febrile delirium, amentia, and delirium tremens,—it is very difficult to trace a clear connection between the hallucinations and the patient's thought. There are some who hold that in this case the hallucination is primary, determined directly by the morbid agent, and that the mental confusion, the motor hyperexcitability, the states of fear, of anguish, and the acts of violence, are only the indirect consequence of the hallucinations. To us it appears much more tenable that even here the genesis of hallucinations makes no departure from the rule and that they are always indirect or secondary phenomena.

In the above mentioned cases we can form only a very

vague and summary conception of the ideation of the patient. We are able to deduce something from his words and actions, but we cannot obtain from him a direct description on account of his ideational and motor disorder. Even on his recovery the patient cannot describe in any definite order the events which happened during his illness, because disordered and incoherent states of consciousness leave only very scanty traces, a point well illustrated by personal experience of certain singularly disordered and illogical dreams. We must not be astonished then if the hallucinatory images are of a strange and incoherent character, if they follow each other just like a series of kaleidoscopic images; but that is no reason for denying the relationship between representations and hallucinations. Extravagant and fleeting hallucinations may be the result of representations equally bizarre and transient. And when one type of hallucination predominates, visual or auditory as the case may be, it is quite possible that there is a predominating type of representative images, a dominant series of thoughts in the confused disorder; and the essential nature of the representations and hallucinations may be traced back to some definite primary alteration of the affective state.

Notwithstanding the above it is not yet demonstrated, however, that representation is the precursor of the hallucination, nor is the hypothesis that the latter is primary, refuted. But against the view that the hallucination is the primary disturbance, there is besides the general principle advanced above, this other fact that these hallucinations and these confusional states are always met with in the relatively grave and acute intoxications. Now these, as we have already mentioned, give rise to conditions which are unfavourable to the appearance of definitely localised or elective disturbances. In these cases the power of election of the toxins is indicated by a simple predominance of certain images

over others. And as a matter of fact the microscopical examination of the nerve centres shows us that while in the acute confusional states the lesions can preponderate in certain cortical regions and in certain elements, yet they are always diffused over the whole cortex and sometimes even over all the elements of the cerebrospinal axis. Hence it is probable that in these cases the abnormal psychic states do not arise as the result of active and localised, but entirely through more or less intense and diffuse stimuli which involve the sensorial centres as well. These diffuse stimuli display, according to the case, a predilection for one centre more than another, and leaving consciousness unaffected simply determine a state of active hyper-excitability. Ordinary stimuli then are sufficient to produce incoordination of the psychic centres, and hallucinatory disorder follows ideative derangement with greater ease the more the sensorial centres themselves are over-excited and therefore able to respond with hallucinatory images to the most transient and incoherent representations which appear in the consciousness of the patient. That the hallucinations so formed are able to add to the psychic disorder cannot be denied, but that fact does not in the least depreciate the value of the hypothesis that they are secondary disturbances.

We must discuss some analogous considerations with regard to the genesis of *delusions*. Delusions proper, which are not to be confounded with the confusional and hallucinatory states found in febrile diseases, the so-called *febrile delirium*, are in the main erroneous judgments regarding the value of external facts, of persons, and of the patient himself, and are determined by a preconception of emotional origin. A characteristic type is the delusion called systematised, on account of the systematic and unvarying persistence of judgments showing similar peculiarities, and co-ördinated with each

other. It assumes various forms: *e.g.*, the delusion of persecution, as a result of which the action of certain or of all persons, and even of external occurrences dependent on physical causes, is interpreted as hostile; the delusion of grandeur, which causes the patient to have an enormously exalted conception of his own personality; the erotic delusion, which makes all incidents fit in with the ridiculous but immovable assumption of a reciprocated love.

The origin of delusions certainly can neither be attributed to destructive lesions, nor to localised coarse excitation. Neither the former nor the latter possesses any constructive potentiality; they can, as we have seen, suppress, dissociate, and disorder the psychic elements, but they cannot give rise to co-ordinated processes such as delusions, which although they do not correspond to the reality, yet follow the normal procedure of thought and often show very great logical coherence. The genetic mechanism of delusions must be very intricate, and, except at its beginning, must come into action according to the normal laws of psychic activity.

It can readily be recognised that every delusion is connected with total or partial disorder of the affections. In the syndrome of melancholia, which is characterised by general depression of spirits—so much so that in the slighter forms this may be the only symptom—we see more or less grave delusions arise which are the effect of a pessimistic interpretation of external and internal occurrences; that is to say, of the outside world and of the patient's own personality. Thus there are delusions of ruin, sin, unworthiness, persecution, disease, and of filthiness. In the opposite condition, mania, which is characterised by a pleasing excitement and by a feeling of unusual capacity for psychic and somatic activities, delusions of the opposite type are found; and their basis is the exuberant optimism which forms the foundation of

this pathological condition. More or less distinct oscillations of judgment related to momentary conditions of mood can also be observed in the normal individual.

Limited delusions, confined to a single object and systematized, always centre round an instinct or a fundamental passion of human nature; *e.g.*, around the instinct of preservation (delusion of persecution); around the passion for possessions (delusions shown by claimants); around the sense of one's own personality, of one's value (various delusions of grandeur, deluded social and scientific reformers); around erotic feelings (erotic delusions); around religious feelings (delusion of being the Messiah, or a prophet).

We may admit then that the affective state is possibly the first to be altered, either through a congenital anomaly or by an acquired disturbance, and that the delusion may only be a reflection of the anomaly or of the affective disturbance on the course of ideas. This influence affects the normal course of ideas. The affections influence the association of ideas not because they constitute links in the associative chain, but because they exercise a dynamic influence which favours or inhibits the associations, or in other words chooses the images and arranges that, of the large number at command, only those directly concerned with the matter in hand find their way into consciousness. The affective disturbance determines a change of general orientation in that the images are chosen from a too one-sided point of view, and a false outlook on what really exists is the result.

In spite of this common genetic mechanism, delusions may assume the most varied forms according to their nature, stability, and varying contrast with the reality. These particular characters arise principally through the concomitance of other defects in the psychic functions. If the disposition is unstable, then

the delusion must be unstable. If intelligence and the critical faculty are deficient either from congenital defect, as in weak-mindedness, or from an acquired defect, as in dementia, the delusions will be crude, trivial, and paradoxical; if there are at the same time grave disturbances of visceral sensation, then extraordinary and phantastic delusional ideas of changes of personality and of the most extravagant somatic transformations may be present; if finally there is mental confusion, then the delusions, too, will be confused and disorderly.

The question of the genesis of *fixed ideas* is much more intricate. These ideas are characterised by the obstinacy with which they remain in the field of consciousness, and by the manner in which they attract to themselves and hold fast the attention of the patient, without there being any justifiable objective reason for their immobility. Moreover, this fixity is recognised by the patients themselves as something clearly morbid, and they feel that it constitutes an obstacle to the normal course of ideas and actions, an extraneous element in the normal current of thought which no effort is able to dislodge.

Fixed ideas may be purely representative in nature, and may consist of words, numbers, phrases, or melodies. But for the most part the form they assume is intimately connected with the actions of the individual. They take the form of representations of useless, frivolous, filthy, or shameful acts, accompanied by the tendency to execute them : *e.g.*, obsessions of counting objects uselessly, of stepping in a certain way, of touching certain things in a regular order, of uttering obscene words, of injuring or killing persons dear to one. Or the natural repugnance associated with certain acts is enormously exaggerated : thus there may be fear of contamination, of contagious diseases, of going into

dangerous places. Or the fixed ideas consist in the representation of the impossibility of accomplishing certain acts, a representation which is translated into a real impossibility: for example, in psychic sexual impotence, in the incapacity for performing certain organic functions at will or in the presence of others, in embarrassment under circumstances in which one would wish to appear at ease, in the fear of examinations. Again, they consist in the representation of involuntary phenomena, which, however, may actually take place through the simple suggestive effect of the representation: as in the fear of blushing, in obsessive insomnia.

In all these cases the constitution of the ideas is evidently unpleasant; the acts, the incidents, the representative phenomena, are always such as to be disgusting, repugnant, and fear inspiring. When the idea is in itself of trifling importance it is its fixity only which renders it unpleasant, and inspires in the patient the feeling of great distaste and uneasiness. It is this fixity which causes the idea to be of interest to the patient, and so a vicious circle is determined; the fear of the fixed idea fastens the attention firmly upon it and renders it more fixed than ever.

Between the idea, the affective state, and the action—voluntary or involuntary—we find some relationships which would be quite physiological except that the normal interaction is intensified and cannot be dissociated. Which link of the chain should be considered the pathological element? All possible opinions have found supporters. There are some who affirm that fixed ideas are due to a primary disturbance of ideation, caused by some parts of the field of representations becoming weaker, others stronger; others make affective disturbance the basis of the whole mechanism and say that the ideas are fixed because they are feared; there is another theory that the fixed ideas are a true primary affection

of will, which is excessively lethargic and unable to control unreasonable impulses, or influence the course of ideation.

Of all the theories the last is certainly the weakest. The influence of volition on the course of ideation is very slight and uncertain, especially when active disturbances of the affections, above all of a depressing character, are present; and indeed disturbances of this nature are always sufficiently strong to induce feelings of anxiety. The ideative theory seems to be applicable only to those few cases in which the theme of the idea claims little attention; but it is certain that in these cases also the affective disturbance—even although it is secondary—predominates, and is the factor which makes the idea a fixed one. Probably the idea which is presented in an unusually insistent manner does not assume the character of a fixed idea until its particular insistence has become an object of attention and a cause of uneasiness, and has been rendered not only harassing but also feared. The affective theory is the one which offers the surest basis. The affective disturbance is the most constant element, and the one which explains how an idea is rendered stable which otherwise would be swept away very quickly by the ordinary current of association.

If we consider the various links of the chain from a pathogenetic point of view, the one which is most easily attributable to a primary disturbance—determined by some general condition of the nerve centres—is the affective state. Individuals constitutionally affected by fixed ideas show special features in their character; they are quiet, timid, placid, excessively reflective persons, given to introspection, with slight tendency to impulse, inclined rather to sadness than cheerfulness. We can see clearly in the episodic appearance of fixed ideas in certain states of organic exhaustion following somatic diseases, that a general action of those influences which

habitually modify the affective tone can form the primary basis of the fixed ideas. Naturally this theory of the affective origin does not exclude the possibility that the theme may be suggested by accidental circumstances. In fact at times the fixed ideas may change and follow one another with remarkable rapidity; there is, as Tanzi says, a diathesis of psychic unrestraint which appears in the form of the most varied fixed ideas. Perhaps other special conditions of the organism can co-operate in the genesis of the fixed idea; probably the obsessions of incapacity depend, if not on a state of real impotence, at least on a deficiency of sensibility and of appetites of which the patient is conscious. The consciousness of this deficiency begins with a feeling of exaggerated diffidence and afterwards begets the obsession.

In considering the psycho-physiological pathogenesis of psychic disturbances, that is to say, the relationship of the objective nervous disturbance with the disorder of consciousness, we must admit that everything is hypothetical at present. We are justified in trying to connect our more general and synthetic knowledge of psycho-pathology with that of the anatomy, physiology, and pathology of the nervous system. The stability of our deductions, and the value of the resultant hypotheses will naturally depend upon the validity of the general data on which these hypotheses are constructed; and the changes which they will undergo in the future will depend on the further development of these general conceptions. The progress of psychology and of the knowledge of the organic basis of psychic processes will gradually restrict the field of the hypotheses and put them on a sounder basis. But the construction of such hypotheses besides responding to a necessity of every scientific mind, is of the greatest use, because general views direct and render more critical the analysis of each particular case, and always stimulate to renewed verification and correction.

V. Etiological Problems

We must now consider the other aspect of the pathogenesis of the phenomena of insanity, that is, the genetic relation which exists between the lesion or the functional disorder of the cerebral cortex—the immediate and necessary factor of the psychic disturbance—and the morbid cause. This connection is in most cases indirect and extremely complicated.

There are very few cases in which the mental disturbance can be considered to be the effect of a cause which acts directly and exclusively on the brain. Perhaps this can only be done when we have to deal with injuries to this organ. Where tumours of the brain or of the structures which enclose it are concerned, the direct action is evident, but the pathogenesis and the etiology of the tumour itself remain obscure. Parasites of the brain also may exercise a local action, but it is necessary to investigate their means of penetration from the intestine and their course through the blood stream, and also the biological cycle part of which is passed by the parasite outside the brain and even outside the human organism itself.

Sometimes a diffuse or coarse alteration of the cerebral mass may occur, and may be accompanied by a destruction of large portions of some centres; but a thorough analysis will at once make it clear that these alterations are not the effect of a cause which acts primarily and exclusively on the brain, but rather the residuum of a general process—toxic or infective—which produces a greater impression on this organ than on any other. This is what happens in the great majority of infantile cerebropathies, which are produced either before birth

or perhaps more frequently in the first years of life, and consist in the destruction of nerve tissues by rupture or occlusion of vessels, in diffuse inflammations of the meninges, in hypertrophy of the neuroglial tissue which leads to an injury of the nerve elements.

In adults also and in old people in whom a hæmorrhage or a softening or some other more diffuse lesion whose distribution is limited to special areas of vascular supply has occurred, we have always to deal with the effects of a lesion of vessels. But this lesion of the vessels exists also outside the brain and may be present throughout the organism, and in any case its cause is to be found in some general condition existing outside the brain.

The *intoxications* and *infections* occupy a most important position among the general causes of cerebral lesions, as they do throughout the whole field of pathology, and the former are even more important than the latter. At least the effects produced by the infections do not depend so much on the direct action of the microorganisms themselves as on the toxins which they supply or which are formed in the organism as a result of their action.

Among the intoxications it is usual to distinguish those which are termed exogenous, that is those which are due to the introduction of poisons from without, from the endogenous which are produced in the organism itself. The field of enquiry concerning the latter is the more difficult because the origin and the means of introduction of exogenous poisons can be readily detected, whereas the genesis of the endogenous poisons is often problematical, and may be easily overlooked in the mass of actions and reactions which take place between one organ and another in connection with functional disturbances. It is therefore often difficult to detect the original cause which determines their production and to trace the details of their mechanism of

action. The distinction between these two classes of intoxications is, however, not so clear as it at first appears. The poisons which are introduced from without may produce chemical disturbances and also lesions of organs which may ultimately lead to a real internal intoxication.

Some *exogenous poisons* are introduced with food; amongst these the most important is alcohol. The poison which gives rise to pellagra is contained, as everyone knows, in altered maize, but the form in which it exists is not yet determined. Other poisons, such as opium, morphia, cocaine, are introduced voluntarily for the sake of the exciting effects which they produce. Others again find their way into the organism insidiously, in the exercise of some occupation which exposes the organism to a continuous contact with toxic substances, for example, lead, or carbon bisulphide.

The effects which an intoxication can exercise on the nervous system vary extremely according to the means of introduction of the poison, to the dose, to the resistive powers of the organism, and to the duration of the intoxication. In alcoholism, for example, we meet with the most diverse conditions—drunkenness, delirium tremens, hallucinatory delirium, and alcoholic dementia—in relation with these various factors.

Only in the acute intoxications, in first attacks or when the attacks are separated by long intervals, can we say that all the symptoms are the result of the direct action of the circulating poison on the brain and especially on the cerebral cortex. In cases of habitual intoxication, and above all when the disease runs a chronic course, the direct action of the poison occupies a secondary position.

The slight chronic lesions of the nerve elements, which give rise to a group of symptoms quite different from those met with in the acute cases, are always

accompanied by changes in other viscera of the body; and the functional disturbances which follow these alterations are not without effect on the brain. Alcohol, for example, injures the stomach, the kidneys, the liver, and probably all the other organs, many of which have not so far been examined sufficiently carefully by pathologists. It is certain, however, that profound alterations of the whole organism, in both its nutrition and its power of resisting fatigue and disease, are produced by these morbid processes, and some lesions of the brain itself may be attributed to them. Among these the injuries of the cerebral vessels are of extreme importance, and there can be no doubt that alcohol contributes largely to their production especially in predisposed subjects.

The prolonged action of some poisons can determine certain processes in the brain which, when once started, continue to advance independently of the primary cause which originated them. It is probable that an overgrowth of neuroglia does not undergo any spontaneous regressive changes, but tends rather to continue the process on its own account and at the expense of the nerve elements. It is well known that functional disturbances, due to chronic poisoning, do not always diminish when the poison is removed, but may remain stationary or may even become aggravated. Processes of this kind may also be started by some acute intoxications especially in young subjects. Certain varieties of cerebral sclerosis, characterised by an intense proliferation of the neuroglia sufficient sometimes to hinder development or to bring about the death of the nerve elements, are the result of some toxic lesion or transient infection which occurred in the first years of life.

It is important from the point of view of psychiatry to know all the visceral alterations which can be produced by each form of poisoning and to recognise all the reactions, anatomical and functional, which these

may produce in the brain. The initial study of these facts has yielded interesting results, but research in this direction is still far from complete.

The *intoxications of intestinal origin*, although they may be spoken of as being produced internally, may reasonably be compared to the external intoxications. The contents of the intestine may be considered as something external from the point of view of the intra-organic products properly so called. But the organism can contribute to the production of an intoxication by means of altered digestive processes and of a disturbed motor function of the gastro-intestinal canal. An enquiry in this direction would teach us a great deal, because there is not infrequently a real vicious circle between the intestinal alterations and those of the nervous system. While, on the one hand, an intestinal intoxication can provoke various disturbances of the nervous system, the functional disorders of the nerve centres, on the other hand, are capable of interfering with the intestinal functions. It is for this reason perhaps that an excessive importance has been attributed to these intoxications as a causal factor in mental pathology. The intestinal disturbance is very frequently the result of some cerebral disease, and when established, it in turn may aggravate the course of the latter, and even give rise to acute exacerbations; but only in a small proportion of cases can it be looked upon as the primary and exclusive cause of the mental disturbance.

The alterations of the so-called *internal secretory glands* are also extremely important. It has been established by physiological investigations that there is, besides a dynamic interdependence which is subject to the action of the nervous system, a close chemical interaction between the various viscera. Some viscera pour

substances into the blood-stream which are necessary to the general economy, or to some particular organs; or they may destroy or utilise other substances which, if present in too large quantities in the blood, would lead to the disturbance of the functions of other viscera. It follows that lesions of these organs produce a considerable alteration in the functional capacity of the other viscera, and complete suppression of their function usually leads to a fatal result. It will be easily appreciated also that lesions of external secretory glands may produce analogous effects, especially if the function of the glands is to remove from the blood the refuse products of the organism, whose retention would give rise to toxic action. In certain cases it appears that the two functions are associated, and that a sharp separation of glands into these two categories is not possible. In any case there is no lesion of any important organ which does not make itself felt throughout the whole of the chemical interchange of the body, and which may not induce a state of endogenous intoxication or auto-intoxication. And the brain, which is extremely sensitive to all poisons, reacts to those which are produced in the organism itself not less intensely than it does to those which are derived from outside.

The best known of all these lesions of organs which cause a well-defined group of psychopathic states, are those affecting the thyro-parathyroid apparatus, which consists of the large *thyroid gland* and the very small but not less important *parathyroids*. Much has been said regarding the function of these organs, and the subject is still much discussed by physiologists. It is generally admitted that both the thyroid and the parathyroids prepare and pour into the blood substances which are necessary to maintain the normal chemical changes of the body. The differences of opinion arise when an attempt is made to define the mode of action of

these substances, and also to distinguish between the function of the thyroid and the parathyroids.

At first it was held that the parathyroids had a function identical with that of the thyroid, that they really represented a supplementary organ, a reserve of young tissue which was ready to enter into activity in the case of any lesion or of any functional deficiency of the thyroid. At the present time, however, there is a tendency to admit that the functions of the two glands are specifically distinct, although closely allied. A trophic function is now attributed to the thyroid which is supposed to be due to some substance elaborated by it, whereas an antitoxic power is claimed for the parathyroids. This assumption is based on the fact that ablation of the thyroid is not in itself fatal, but it determines grave disturbances and arrest of development in young organisms. On the other hand, removal of the parathyroids causes death in a short time with symptoms of acute intoxication.

These two hypotheses of a chemical trophic action and an antitoxic action are not, to tell the truth, very clearly separated from one another. A chemical trophic action may be nothing more than an antitoxic action. We may suppose that the thyroid itself neutralises some poisons, less virulent possibly than those which are neutralised by the parathyroids, poisons which have a slow and mild action and are capable of injuring the organism but not of destroying it; it is possible also that these are poisons which can be eliminated to a certain extent. Trophic disturbances and arrests of development may possibly be due to the action of these poisons. There is another fact which is in opposition to the assumption that a profound difference exists between the action of these two organs. Baumann, the chemist, has extracted a well-defined substance, *iodothyrine,* from the thyroid, which appears to be, if not the only, at least the most important active principle of that organ. But the

parathyroids also contain this substance, and even in greater quantities, if we consider their small volume. This fact strongly supports the idea that there is an analogy, one might even say a close affinity, between the functions of these two organs, although it does not exclude the possibility that there is some specific difference between them.

Very little is known, however, as to the means by which the absence or the diminution in the quantity of the substances which are elaborated in these glands affects the chemical activities of the organism. The researches of Coronedi prove that these substances are necessary for the carrying out of the syntheses which must take place in order that the nitrogenous products of metabolism may be prepared for elimination by the kidneys. An incomplete activity of the thyro-parathyroid apparatus would therefore be followed not only by a renal insufficiency, but also by an anatomical lesion of the kidneys, and the complex of symptoms would depend to a large extent on the lesion of these organs.

Now it is a well-known fact in human pathology that *endemic cretinism* is a morbid syndrome which results from a functional insufficiency of the thyroid gland. Similar groups of mental and, to a certain extent, of bodily symptoms appear whenever any lesion whatsoever produces an insufficiency of thyroid activity. In the *myxœdema of adults,* which follows grave lesions of the thyroid, either from disease or extensive resection of the gland, we see a characteristic psychic torpor and a peculiar trophic alteration of the skin, the myxœdema. Both these characters are met with, to a greater or less degree, in *endemic cretinism*; but as the agent which injures the thyroid in this case acts in an early period of life, the skeletal development is also influenced unfavourably. This effect is even more marked in certain cases of so-called *sporadic cretinism,* in which the thyroid is injured or absolutely destroyed in earliest infancy.

In this condition, besides the torpor and the myxœdema there is an arrest of somatic and psychic development, so that an individual of fifteen years or more has all the appearance of a mere child. That the pathogenesis of this morbid picture, in all these forms, is closely connected with the thyroid gland is demonstrated very plainly by the fact that all the symptoms become modified or rapidly diminished if either fresh or dried thyroid is administered by the mouth. Even the arrest of development can be overcome to a remarkable extent, if treatment is undertaken at a sufficiently early period.

It is not probable that the parathyroids take any part in these morbid conditions, because they have been found almost normal in many cases in which an autopsy has been made. The cause of the lesion of the thyroid is obvious in the majority of the cases of myxœdema in the adult and also in many cases of sporadic cretinism. But the cause of endemic cretinism is still entirely hidden. All the known facts support the hypothesis that there is an external cause, which is connected with certain localities, which acts on the organism at an early age and produces a slowly progressive lesion of the thyroid gland. But it is not yet possible to decide whether this cause is of a chemical or biological nature, whether it consists in an excess or defect of some organic or inorganic substance in the fluids of the body, or perhaps in some unknown micro-organism. Our ignorance on this point is principally due to the fact that the investigations by analytical means have never been conducted with sufficient precision. The valleys in which cretinism flourishes are distant from scientific centres, and the enquiries on the subject have been left to those who, however willing they may be, have neither the training nor the necessary means for such a delicate research.

Another morbid condition which forms a complete contrast to that of cretinism, which affects the mental

activity and often leads to a definite form of insanity, is the so-called Basedow's disease. In this disease there is generally a manifest hypertrophy of the thyroid. It was natural therefore to associate the group of symptoms, so opposed to that of cretinism, with a functional hyperactivity of this gland, just as cretinism is connected with an insufficiency of its action. The most recent investigations show, however, that the relations are not so simple as this. Even if there is a hyperactivity of the thyroid there is in all probability a lesion and a functional insufficiency of the parathyroids. This is assumed because of some conditions which have been discovered by post-mortem examination, and also because of certain symptoms which are characteristic of this insufficiency. But it yet remains to be determined whether there is any interdependence between these two lesions; whether, for example, the lesion of the parathyroid is primary and that of the thyroid secondary and perhaps accessory, a sort of compensatory effort on the part of the gland.

The recent researches on the function of the *suprarenal capsules* have assumed an immense importance from the point of view of mental pathology. It is now accepted that these organs secrete a special substance, *adrenalin*, which acts as a very powerful tonic on the blood vessels when injected into the circulation, which favours their contraction, and thus leads to an increase of blood pressure. Experimental injections of this substance produce in fact a vascular spasm and a most marked rise of blood pressure. It is also important to note that repeated injections, even in minute doses, soon lead to serious lesions of the arteries. The idea naturally arises from this that arterio-sclerosis is intimately connected with an overaction of the suprarenal capsules; and this seems to be the more probable because clinically the connection between arterio-sclerosis and arterial hyper-

tension is well recognised. It is true that similar processes of arterio-sclerosis can be produced experimentally by other substances, for example, nicotine; the arterio-sclerosis is not therefore a specific effect of overaction of the suprarenal capsules. But it has yet to be decided whether these substances which are capable of causing the arterio-sclerosis produce this result by altering the secretion of the suprarenal glands, or more directly by exerting a tonic and vaso-constrictor action on the vessels. The two hypotheses are both possible, and it may be that each is true for particular groups of substances.

The importance of this group of facts, from the point of view of the alienist, becomes evident when we remember that arterio-sclerosis is the cause of many cerebral changes in the senile and pre-senile periods of life. But it has a wider interest for many reasons. It appears that there is a certain connection between the functions of the suprarenal and the genital glands; the involution of the latter reacts on the suprarenal capsules and produces an overaction in them. If this should be confirmed, it would provide a clear explanation of the occurrence of the arterio-sclerotic psychoses during the involutive period of life. It is necessary that some systematic investigations should be carried out regarding this point, and also with regard to the condition of the suprarenal capsules at different periods of life. It must also be remembered that the secretion of adrenalin is not the only function of these organs. Adrenalin is elaborated in the central portion of the suprarenal capsules, in the so-called medullary substance. There are other portions of these glands which have an entirely different structure, but absolutely nothing is known of their functions. Researches directed to the elucidation of the physiological function and the pathology of the two portions are urgently required, and

they might possibly lead to results not less surprising than those already obtained.

Lesions of the *kidneys* also frequently give rise to mental disturbances; in fact these are never absent in advanced stages of the disease when death is approaching. But in these cases, no matter how grave the symptoms may be, even if they lead to the most complete psychic paralysis, they are usually regarded as a simple complication appearing just before death and not as a real mental disease. But sometimes the psychic symptoms form the most striking feature of the illness, in fact the renal disease is so insidious in its progress that it is often unrecognised. And the picture is not always the same; it varies according to the intensity of the disease, and probably also according to the special nature of the renal lesion. There may be an acute condition of hallucinatory confusion with intense agitation and fatal convulsive attacks; on the other hand, there may be a general chronic obtuseness of the psychic faculties comparable with the effect of cerebral compression by a tumour, or a simple condition of dementia such as is common in progressive paralysis. And as a matter of fact the differential diagnosis between these various conditions may offer considerable difficulties. Lesions of the kidneys form a frequent and important complication of chronic mental diseases, especially of senile dementia, of chronic alcoholism and of progressive paralysis. In every case the renal disease forms only one link in the chain which connects the mental symptoms with the disease; and the renal lesions may, as is known, be determined by various causes—by the most varied acute and chronic intoxications, by many infections and by arterio-sclerosis—and may appear in different forms, with varying intensity and with diverse results.

Turning now to the *sexual glands,* we find that it is generally supposed that a generic connection exists

between physiological changes in these and mental diseases. This supposition is based on the fact that the periods at which these organs become active, or cease to carry on their function and undergo senile atrophy, are usually accompanied by particular diseases, some of which are peculiar to puberty and others to the involutive period. The period of puberty is generally considered to be especially dangerous because the system is supposed to be flooded by some hypothetical internal secretion capable of determining lesions or functional disturbances of the cerebral cortex and through them insanity. But the relationships are probably not so simple as this. Both puberty and the involutive age are marked by a whole series of changes in the general condition of the organism and in that of individual internal organs, and the relations of interdependence existing between functions apparently distinct are not yet clear. But the example already mentioned of the connection between an atrophy of the sexual glands and a consecutive hyperfunction of the suprarenal capsules shows very plainly how remarkable and unexpected these relations may be.

This field of enquiry is certainly of the greatest interest. Speaking generally, all the alterations of the visceral glands are important from the point of view of psychiatry, because certain chronic syndromes which arise without any obvious cause in apparently healthy individuals may, in all probability, be attributed to them. But the changes of the sexual glands are of importance in a special manner because we know—at least in a generic sense—that not only are their functions of extraordinary importance in our psychic life, but that they also exercise by means of some obscure sympathy an influence on all functions, on the development of the organism and on the state of its nutrition.

The mechanism by which the *infections* act as causes

of insanity varies immensely. Only in a few cases can we assume that the reaction of the nerve centres is the direct result of micro-organismal invasion. This does occur in rabies, in sleeping sickness, and in the psychoses following influenza, but even in these instances the toxic action which the micro-organisms exert on surrounding structures is much more important than the direct lesion which they themselves can produce by invading the nerve tissues.

In all the infective diseases marked psychic disturbances may appear, and they are usually present in grave conditions of illness, either at or just before death. The accompanying fever may either exaggerate these disturbances or may be the original cause of them, giving rise to the well-known condition of febrile delirium. But all these phenomena are usually looked on as accessories of the infective disease, and not as a mental disease apart from it. True mental diseases of infective origin appear, however, during the period of convalescence or afterwards, when the infective process is at an end. But these cannot be attributed either to the direct action of the micro-organism or to the toxin which it can produce; they are rather to be considered as secondary effects of the infection, such as the formation of secondary toxins, the secondary disturbances of metabolism, alterations of the viscera, or the state of emaciation and inanition.

Sometimes infections leave no evident disease behind, but only a weakness, an unhealthy condition, which later under the influence of other causes may give rise to a true mental disorder. At other times the mental disease may be the result of an infection acting on a predisposed soil. The infection acts as a stimulus to the latent predisposition, which possibly would not have become manifest without its aid. In fact after infective diseases certain psychoses are sometimes observed which are generally considered to be dependent

on some obscure individual predispositions and usually develop without the co-operation of any evident external causes.

The connection between an infection and the mental disease may declare itself after the lapse of many years. It is now admitted that there is a direct relationship between syphilis and progressive paralysis, and it is recognised that the paralytic process does not exhibit the usual characteristics of syphilitic affections; on the other hand, twenty years or more may elapse between the infection and the outbreak of the mental disorder. This suggests that the former disease leaves behind it some obscure alteration which cannot be detected, and which requires a great length of time before it manifests its injurious influence on the nervous system.

Lastly, just as the infections can damage the brain directly by means of the toxins produced by them or formed in the process of the reaction of the organism against them, so they can also injure other viscera, and thus a numerous and complicated series of indirect attacks on the brain may be started. Most of the lesions of other glandular organs, which we have referred to above as causes of mental disorders, depend entirely on infections. Alterations of the vessels also are often due, directly or indirectly, to the same morbid antecedent.

A complex question, and one which is still unsolved, is that of the importance which must be attached to *exhaustion* as a cause of mental disease. A state of exhaustion of the nerve centres is often spoken of as being the origin of certain morbid conditions, which are generally of grave import and manifest themselves after exhausting disease when the organism is reduced by fever, by deficiency of food, and by general disturbances of every kind, to a state of evident malnutrition.

But exhaustion must not be mistaken for fatigue.

Fatigue is due to functional activity; it does not result from a wasting of the organ, but rather from an interference with its functional capacity dependent on the action of the refuse products formed during activity. And if these are removed the function can go on. These refuse products do not necessarily belong to the nervous organ, but this organ may be affected by those which are poured into the circulation by the muscles and by the whole organism. Fatigue is therefore a general phenomenon, and sleep, which is its chief characteristic, must be due to a kind of physiological intoxication, the origin of which lies largely outside the nervous system. Exhaustion, on the other hand, is considered to be the result of a consumption of the active elements of the tissue, by which the functional capacity and also the power of organic resistance become diminished.

The excellent experiments of M. Verworn on the nervous system have shown that excitability is due to the presence of oxygen in the ultimate molecules of which living protoplasm may be considered to be composed, in the molecules of "biogene," as he calls them. The activity of protoplasm, in response to stimuli, is the result of a process of internal oxidation. Apparently the nitrogenous elements are not consumed in this process, but the whole reaction depends on a combination of oxygen with certain hydrocarbon groups, and on their subsequent separation from the molecule of a biogene. The loss is promptly repaired by the absorption of fresh oxygen and hydrocarbon groups, which redintegrate the molecule, and maintain it ready for other functional cleavages. When the supply of oxygen is stopped, reaction to stimuli goes on until the store of intra-molecular oxygen is exhausted; the nerve protoplasm then loses its excitability. It is to this condition of inexcitability that Verworn applies the term exhaustion. This conception of exhaustion, however, is, as one may

see, very different from that which is commonly accepted in pathology.

The molecules of biogene also undergo processes of decomposition which are more radical than those described above, processes of cleavage in which nitrogenous elements are lost. This separation, which is independent of functional activity, normally goes on to a limited extent only, but it can be augmented by pathological causes. When the limit of functional exhaustion indicated above is reached, this cleavage proceeds on a larger scale, until the redintegration of the molecules of biogene is no longer possible. In asphyxiated tissues there exists a complete functional paralysis, which is rapidly succeeded by a destructive alteration of the nerve elements, even if the supply of oxygen is restored.

The nerve elements therefore must draw two distinct kinds of material from the circulating plasma; materials which are concerned with functional disintegration, consisting in oxygen and hydrocarbon compounds, and nitrogenous substances, which are employed in reconstructing the molecules of biogene whose nitrogenous constituents have been more completely split up. Now it is very difficult to imagine that there can ever be a complete absence of the supply of these materials for the nerve elements while the circulation is still preserved, even if the functional activity is pushed to excess. The renewal of the oxygen goes on freely and continuously. An asphyxia due to an excessive consumption is almost inconceivable. The repair of the other materials also, whether nitrogenous or not, must be very readily carried out, either because the amount of consumption is small as has been shown by recent study of the changes which accompany nervous activity, or because a good supply of nutrient material is constantly provided by the circulating blood-stream. Even when the general organic consumption is not repaired by food, and the whole organism suffers from a deficiency of

nourishment, the nervous system occupies a privileged position compared with the other organs, and obtains the materials necessary for repair before any of the others. In the condition of absolute inanition the brain is the organ which loses least in weight, and in fact the loss is almost insignificant. It makes use not only of any nutrient material which may be at hand, but also of that which is set at liberty for the preservation of life by the less important organs during the process of inanition. Histological investigations also demonstrate that the nerve elements have an enormous power of resistance to the effects of inanition, and only when the whole organism shows signs of failure do they commence to offer evidence of nutritive and morphological change.

Within the limits of physiological activity, therefore, we must not attribute either the weariness connected with protracted mental labour or the sense of weakness or of faintness which is felt by every normal individual when he has been without food for an unusually long period of time, to any deficiency of nutrient materials. In the first case certain psychological factors may be introduced, such as the necessity of exercising the muscles which have been too long in a state of inactivity; in the second case the most important factor is related to reflex vaso-motor phenomena and to uncomfortable sensations which proceed from the digestive organs.

We cannot even explain the disturbances which are usually attributed to the effects of exhaustion as being due to a simple deficiency of nutrient material. Deprivation of oxygen produces a general paralysis, the paralysis of asphyxia; and when localised and prolonged it leads to a necrosis of the asphyxiated tissues; but the syndromes produced by exhaustion cannot be attributed to such an action, and even when they are present only to a slight degree the mechanism of their production is quite unknown. They are certainly not due to a deficiency of nitrogenous materials or of hydrocarbons, because,

as we have seen, these are always present in sufficient quantity to satisfy the needs of the nervous system.

We must therefore look elsewhere for the cause of the presumed defect of redintegration, and inquire whether any other factors take part in the production of the disturbances which are attributed to exhaustion. A recent theory, which has been advanced by Edinger, deals with some of the accessory factors which may assist in determining a disturbance of the relations between organic consumption and redintegration, by means of which an injury of the anatomical elements may be produced. This theory has been advanced in order to explain the systematised nerve lesions, but since it is based on general facts of the physiology and pathology of the nerve elements it has a general application.

Edinger states that certain systems of neurones may degenerate in consequence of a deficient compensation for the chemical losses which accompany functional activity. In certain cases the failure of compensation would be produced by a prolonged excess of functional stimuli; in others the excess of function would be only relative. If a system of neurones, originally weak, were kept in activity by a quantity of normal stimuli which for it is excessive, it would not be capable of functionating effectively; it would be subjected to a continuous strain and would not be able to repair its losses. The intoxications would be enabled to come into play as an accessory factor, limiting still further the power of redintegration of the anatomical elements.

It is very improbable, however, that a simple excess of functional activity in an organ which is anatomically normal and whose metabolism is carried on in a normal manner, can produce a morbid state. Under such conditions a compensatory adaptation in the shape of a hypertrophy is rather to be expected. It is true that in the long run an excess of work can lead to the failure of hypertrophied organs, but it is not likely that this could

happen in the nervous system. Physiological experiments show that the chemical consumption during nervous activity is extremely small, and the nerve elements possess a wonderful resistance even to stimuli of an intensity and of a duration beyond any degree which could be experienced in the most extraordinary conditions of life.

A *congenital weakness* of certain systems is, without doubt, of the utmost importance in the genesis of many neuropathies. We shall attempt later to form some conception of the pathological value and of the genesis of such a weakness; we shall see that it can not be comprehended simply from a quantitative point of view, as a defect of proportion, such as would render the necessary functional restoration impossible. The genesis of this weakness is pathological, and always indicates a qualitative change. In any case it is highly improbable that any such weakness plays a part in the pathogenesis of the so-called states of exhaustion, which affect the whole nervous system, and are often met with in individuals who have never shown any sign of predisposition or of any functional deficiency of the nervous system.

But the maximum importance must be attached to the last factor, the toxic factor. As we have said already, the disintegration of the nitrogenous constituents of the living molecules of the nervous elements is independent of function; and, further, it is the only change which can inflict a permanent injury on the anatomical unit. The reconstitution of the disintegrated elements takes place regularly under normal conditions; age alone has an influence on it, in so far as the redintegrative capacity weakens in old age, and may perhaps tend towards complete abolition coincident with the ultimate limit of vitality. But it is quite easy to understand that this capacity for redintegration can be hindered or diminished by the intoxications, which introduce an extraneous and

disturbing element into the chemistry of the living molecule.

The so-called states of exhaustion manifest themselves in fact as a sequence to diseases in which many toxic factors constantly exert an influence. Among these we may mention the infections, intoxications, fevers, inanition, insomnia, diffuse visceral lesions, and over-action of the nerve elements in response to toxic stimuli. To admit in these cases merely a want of compensation in the nutrition of the nerve centres, whether due to excess of stimuli or to defect of nutrient material, would be a simple but artificial explanation, an explanation in fact which is contrary to all the evidence of the action of pathological agents. There can be no doubt that the toxic factor should be taken into consideration before any other, not only to explain a final state of deterioration of the nerve elements, but also to find in it the pathological stimulus which submits the nerve elements to an inopportune and abnormally protracted functional activity.

The co-operation of many morbid factors is therefore a condition of things which is most favourable to an excessive expenditure of the constituents of the nerve elements. This has been clearly demonstrated by the recent experiments on the pathological modifications of the neuro-fibrillary reticulum. Donaggio has found that cold or inanition acting separately does not affect the reticulum in the adult rabbit, but that if they are associated they produce profound changes. Bacci also has seen analogous lesions induced by the co-operation of cold and of the intoxication which follows the removal of the thyroid gland; these are not observed if the two factors act separately. Particular physiological conditions of lessened powers of resistance also may co-operate in the production of such lesions. For instance, lesions of the neuro-fibrillæ are produced in young animals by the simple action of cold (Cajal) or of various

intoxications (Marinesco) which in the adult do not give rise to any apparent alteration.

An extraordinary importance has always been attached to *psychic causes* in the genesis of insanity. But this importance becomes restricted, and is in fact much diminished if not altogether dissipated, when an attempt is made to explain the mechanism of their action. We have already seen how difficult it is to conceive of an injury to the nervous system being caused by a simple excess of functional activity. A much more considerable influence may be attributed to the *emotions*, especially if long continued, not because of the chemical consumption associated with the nervous activity which accompanies them, but because of the indirect effects which they exert on the organism. The injurious influences which protracted depressing emotions have on the appetite, on the digestive processes and on nutrition generally are well recognised, and it is not at all improbable that they can determine some auto-intoxications through the production of these disturbances of nutrition. It is clear that these injurious effects must react on the nervous system, must diminish its powers of resistance to all shocks and morbid influences, and must also lower the general resistance of the organism to diseases, and thereby favour the genesis of mental diseases. But we do not meet with, nor is it possible to imagine, any fixed specific relation between the emotions, no matter how protracted, and some special form of mental disease. Even the forms of insanity which are considered to be most easily influenced if not determined by psychic causes, may arise independently and without the slightest participation of any psychic disturbance.

There are cases, however, in which the onset of the insanity follows so immediately on an extremely intense psychic impression, that it—at least to the casual onlooker—appears to be a direct and exclusive causal

factor. But this occurs for the most part in individuals who are the subjects of a grave predisposition, who possess in a latent state the organic conditions favourable to an outbreak of insanity, and the psychic impression acts merely as a violent stimulus which discloses the defect and determines the initial disturbance of the equilibrium of the functions. We see here the same process of which we have so striking an example in certain cases of epilepsy. A child sickens with some infective disease, presents certain cerebral symptoms, and recovers. For many years after he does not exhibit the slightest disturbance which could lead to a diagnosis of any cerebral weakness. But, following a fright, he suddenly suffers from a series of epileptic seizures which are repeated periodically and become more severe and also more frequent. At the autopsy, however, a gross cerebral lesion is often found, a residuum left by an encephalitis, which dates back without doubt to the disease which manifested itself during infancy. In this case it is evident the conditions favourable to the outbreak of the epileptic attack had been slowly developing in the brain. The fright merely acted as a stimulus which revealed these conditions, and even if the fright had never occurred, the convulsions would have appeared later in connection with some accidental and unimportant cause or perhaps, as so often happens, without any apparent external stimulus at all.

But the psychic causes may become active through another mechanism. We have already seen that not all the psychic disturbances in insanity can be attributed to the cerebral lesion. This lesion determines a certain group of primary disorders, but the remainder of the morbid picture is simply the result of secondary disturbances, of the reactions of centres which are still healthy to the pathological stimuli which reach them from the injured portions. The interweaving of these secondary disturbances takes place according to the empirical laws

of normal psychology. Now it is in this field of secondary disorders that the intervention of the psychic factors can make itself felt and increase the disturbances due to the organic lesion. If, for example, a melancholic is informed of some misfortune, he will, without doubt, accept the news as true without any inquiry, and delusions and states of anguish will arise therefrom. If the most flattering compliments be paid to a self-satisfied and grandiose paralytic they will be received as a perfectly natural tribute. In a patient suffering from paranoia it is quite easy to provoke a more exaggerated series of delusions by designedly awakening his suspicions or his pleasing vanities. This process may in fact occur spontaneously in the patients, and even normal impressions are accepted and assimilated as elements which contribute to the elaboration of delusions and other morbid processes. We may not therefore, in this sense, speak of a psychic origin of a disease but of special symptoms, of particular episodes.

But there are some affections, for example hysteria, in which all the symptoms of disturbance seem to have such an origin. We must admit therefore that in this disease the psychic causes possess an exceptional importance. Analogous conditions are met with also in certain forms of constitutional neurasthenia. But it is evident that in this case the real morbid process does not consist in the elaboration of any single idea, but in some obscure and unknown fundamental disturbance which causes the psychic organism to react to external stimuli in an abnormal manner, and it is these stimuli which in reality are the so-called psychic causes. We do not know in what this disturbance consists. It may be a purely dynamic trouble or it may depend on extremely minute anatomical anomalies, or on a functional anomaly, secondary probably to a constitutional abnormal metabolism. But in any case we cannot regard the external psychic stimulus as the cause of the disease; we must

admit that this depends on an internal, unknown, but organic anomaly.

Among the determining factors of insanity *social causes* are also frequently mentioned. In reality these do not form a special category of causes, but a particular group, which, from one point of view, we have already discussed. If certain occupations predispose to particular intoxications, if others facilitate special infections, or expose those concerned to intemperance, to over-work, or to insomnia, this does not alter in the slightest degree the biological value of the intoxication, of the infection, of the over-work, as the cause of the insanity. Social position, conditions of misery or affluence, the professions, business occupations, tend only to provide a predisposing environment, by reason of which certain individuals are more exposed to one group of causes than to others. This is of the greatest importance from the sociological point of view, and especially in regard to the question of prophylaxis, but it has nothing to do with the pathogenetic mechanism.

External causes, whose power of ingenerating insanity is unanimously admitted, do not act in the same way and with equal force on all individuals. This fact is proved more easily in connection with the intoxications of external origin than with any other cause, because they may be subjected to an exact quantitative estimation. We know that there are some individuals in whom the phenomena of alcoholism become manifest after the habitual ingestion of quite a moderate quantity of alcohol, while other individuals exhibit no marked disturbances even after the daily use of enormous quantities of alcoholic liquors. Nor is the appetite for alcohol uniformly strong. A total abstinence from alcohol requires no effort in some people, in fact the use of alcohol is repugnant to them. Others feel a variable,

brief, episodic desire for it, and can easily pass from excess to a moderate use of it or to total abstinence. For others again, it has an irresistible attraction, it is a need which becomes accentuated with its use and abuse, and against which all the force of the will avails nothing.

Analogous differences are observed in connection with every variety of cause. In some a slight elevation of temperature will cause delirium, while others maintain their lucidity of mind even with the highest temperatures. Among those who contract syphilis only a small proportion become paralytics. The puerperium and lactation produce no mental disturbance in the great majority of women, but in others they determine forms of insanity which rapidly pass on to dementia.

We recognise here therefore a phenomenon which is well known throughout the whole of pathology, that is, that the external cause of disease is associated with an internal factor, viz., *predisposition*. In any organism which may appear to be entirely healthy and which under ordinary conditions functionates in a normal manner, there may be hidden weaknesses which render it more vulnerable to one morbid agent than to another.

The problem regarding the nature of predisposition is of interest in the whole realm of pathology, but it acquires its maximum importance in psychiatry, because in many cases this internal factor preponderates to such an extent that the value of external causes becomes almost insignificant, so much so in fact that it comes to be regarded as an occasion for, rather than as an excitant of the disease. Not only so, but there are some morbid conditions in which the influence of the external cause it not at all apparent, and the whole psychopathic process seems to be the natural product of the spontaneous development of a congenital internal tendency. These constitute the mental *anomalies* which stand in marked contrast to the *diseases* properly so-called.

We are accustomed to consider disease as an abnormal biological *process,* the result of some external action which injures the organs and disturbs their functions, to which the organism reacts sometimes victoriously and sometimes ineffectually; in the latter case it succumbs. An anomaly, on the other hand, manifests itself to us as a *state* of the organism, as a particular condition of its existence, and genetically as an aberration of organic development with which a functional aberration is associated. As a consequence, not only are the psychopathic disturbances to which it is impossible to assign an external origin, usually included in our conception of an anomaly, but all the predispositions also and all the internal factors which can co-operate with the external causes to give rise to the morbid process, and which represent a suitable soil on which the external cause may act. The anomalies and the predispositions are generally regarded as phenomena which are not only congenital but also hereditary.

The anomalies may always be distinguished one from another by their descriptive characters. But when a predisposition is spoken of in general terms, it is referred to as a constant factor having no definite characters, which may be associated with any variety of mental disease. This is an absolutely erroneous view. Not only on the grounds of our general ideas of pathology, but also on the grounds of special clinical experience, must we admit that there is not one predisposition, but rather there are many predispositions, quite distinct and specific, which are not mingled together indiscriminately, but are such that one excludes another.

Only as a result of vague and superficial knowledge can insanity be ordinarily considered as a single phenomenon complex, bound generically to an indefinite disturbances of one special organ, the brain. We know in fact, that the brain is not a single organ, but a combination of different organs, specifically distinct,

which exhibit the most diverse selective affinities in the presence of morbid, and especially of toxic, agents. Mental diseases are due to processes which differ enormously one from another. The pathogenesis of these also differs immensely and involves alterations in various viscera as well as in special portions of the brain. Similar conditions hold good for the predispositions. They consist in a latent defect of the organism, which only reveals itself under certain conditions of trial, but they may assume the most diverse forms, and may appear in the most widely separated regions. A predisposition may depend on a want of harmony in the development of particular cerebral organs, and in such a case the possible combinations are innumerable. It may depend on congenital conditions of hyperfunction or of weakness of this or that organ, or of various apparatus, for example, of the digestive, or the renal excretory apparatus, of the thyroid gland or of the genital organs. It may depend on some disorder of metabolism, or rather on a simple tendency towards some special disorders.

But whatever it may be, predisposition has come to be always regarded as a defect. Whence is this defect derived? Is it a specific characteristic of a certain stock, or is it the effect of some morbid agent acting from without?

There is no doubt that certain morbid predispositions are not only acquired, but acquired in adult life. The most striking example of this is seen in the attraction and at the same time the intolerance for alcohol which is often developed after injuries. And the same result can be brought about by various infective diseases. As far as alcoholism is concerned, even chronic diseases of the nervous system in general or of the brain in particular may constitute a predisposition, either in the direction of intolerance or in that of desire for drink, or in both. Many paralytics become the victims of alcoholism in the

early stages of the disease, and an intolerance for alcohol, even in small doses, is very marked in epileptics.

We have seen that a predisposition, which may be defined as a want of harmony or as a state of functional weakness in some organ, can be acquired during adult life when development is completed, but it must be much more easy for it to arise during the course of development. We know that in the nervous system the separate systems of neurones do not reach their maturity simultaneously, but one after the other and over a long period which extends as far as the limits of childhood. At birth the greater part of the cerebral cortex is still in an absolutely fœtal stage of development, and must be considered as entirely unable to functionate. If, as appears certain, the systems of neurones in course of development, are very easily injured, it follows that the genesis of the weaknesses, the delays and arrests of development of the separate systems, may occur in a chronological series corresponding to the different stages of normal development. They may, under normal conditions remain hidden in the adult, but may be revealed either under the influence of particular morbid agents or when the feebler systems are subjected to some exceptional strain.

The forms of spontaneous systemic degeneration of neurones which may become manifest in infancy or at a later age, originate in this way. Some morbid cause has produced that state of frailty, of weakness, which, according to Edinger, gives way more easily before an excess of function or an insufficient redintegrative action.

This defect of constitution always implies a qualitative variation, and if it is accompanied by a deficiency of size or volume it must still be attributed to a qualitative variation which is the result of the action of some morbid agent.

During development the living organic molecules are capable of multiplying, and when development is

completed they may still multiply under the action of exceptionally intense and protracted functional stimuli, and thus give rise to hypertrophy. In any case they must possess a tendency to numerical increase, sufficient to compensate for any loss due to the dissociation which goes on here and there on account of either normal or pathological reasons.

This process of compensation diminishes in old age, and it is then that senile atrophy begins to appear. The evolution of this capacity for multiplication of the living molecules characterises the active periods of the life of the organism and of its constituent systems. If the development of an organ remains incomplete, it is a sign that the capacity of its living molecules to increase has been diminished by the action of some morbid cause. And it would naturally be expected that this diminution should be accompanied by a weakening of vital resistance, an *abiotrophy*, as Gowers expresses it, or a *diminished longevity* of the organ, as Catòla describes it. This disturbance is sufficient to establish an inequality between the length of life of a given system and that of the others, and the affected system may at a more or less advanced period of life undergo a spontaneous deterioration. But it is quite probable that other additional causes—the influence of toxins or of simple overaction—may, as Edinger says, accelerate the organic failure and produce a degeneration of the system which has already been debilitated during embryonal development.

Let us now go further back in the genesis of the individual and consider the act of conception. We may assume that the germinal elements themselves can be modified by morbid influences. Only in this way is it possible to explain the part played by the father in the formation of the anomalies and of morbid predispositions. There are some who maintain that a condition of intoxication—and of the father alone—at the time of

fecundation may exert an injurious influence on the germ. And although observations of this sort are always full of fallacy, it cannot be excluded that such an injurious effect is possible, and in fact is not altogether improbable.

Considered in this way, the anomalies, and with them the simple morbid predispositions, would seem to be the effect of a real pathological process, determined by an external cause. Perhaps the most striking aberrations among psychic temperaments which are on the borderland of the pathological, certain psychic discords which are ordinarily regarded as the expression of normal individual variations, may be thus explained. Anomalies and morbid predispositions are therefore diseases in the widest sense of the term, but diseases of which the external causal factor can with difficulty be detected during the development of the organism and which may in fact depend on some morbid conditions of the progenitors. During embryonal development the organism is defended as far as possible from the direct influence of external influences, but it cannot be protected against the injurious effects of disease of the parents and especially of the mother.

From this conception of the anomalies and predispositions we now pass to the consideration of *degeneration*, taking this term to mean a disease of the stock, a morbid process initiated by external causes, which is not developed in a single organism but in a series of subjects in two or more generations.

It is evident that there is only a partial connection between degeneration, as thus defined, and *heredity*. If heredity be interpreted as the complex transmission of every variety of biological character from one generation to another, then degeneration may be considered in this sense to be hereditary. But this is not the true biological significance of heredity; heredity is the

invariable transmission of biological characters. If a morbid cause acts on the whole of an organism, it can exert an influence on the sexual cells or the germs, and as a consequence give rise to some deviation or arrest of development. But this mechanism, which as a matter of fact results in the production of a pathological *variation,* can in no way be compared with that which, as far as possible, transmits the specific physiological characters unaltered. The simple occurrence of some deviation of development in one generation is not sufficient to guarantee that the same shall necessarily be repeated in succeeding generations. Nor need the form of this deviation of development exhibit any close resemblance to the modification of the somatic tissues of the progenitors which had been produced by the action of some external cause.

What has been said regarding the pathological deviations may, up to a certain point, be applied to those closely allied variations which are produced by the influence of an environment which may not be injurious but indifferent or even advantageous. We know how much discussion there has been on the subject of the hereditary transmission of acquired characters, and certainly in the present state of the organic species it would be very difficult to prove that it does occur. Even if it is possible to cite many instances of acquired characters which manifest themselves in successive generations and also of mutilations which give rise to congenital malformations in the offspring, still the results of experiments are by no means so constant as they should be if such a transmission is effected by an established mechanism, by an almost inevitable necessity of the organisation. It must be remembered that morbid variations are always something peculiar to the individual, and it would at least be remarkable if such variations, which are in no way the effect of some adaptation but rather an indication of a weakness or of

an injury, should enjoy a special privilege and be capable of perpetuation by hereditary transmission.

A complete and satisfactory theory regarding the *hereditary transmission of acquired characters* forms one of the fundamental needs of biology, perhaps the most important of all, because the problem of the hereditary transmission of acquired characters embraces the whole of the general problem of heredity, and this is intimately connected with that of the origin of life. If the hypothesis of special creation be rejected and the theory of evolution accepted, it is impossible to deny that all organic qualities must have been acquired at one time or another, and the mechanism of normal heredity must be the resultant, the sum of the processes by which the separate characters have become hereditary.

Heredity is not, as is so often imagined by biologists, a necessary property of living matter, comparable to the inertia of matter, a sort of biological postulate which does not require a genetic explanation for itself. It is, like all biological phenomena, a product of evolution; it is an adaptation, the prototype of all adaptations. Moreover, it is of fundamental importance, because without it life itself could not have been preserved nor could there be any stability of form or of mechanism. But it is an *acquired adaptation* which certainly could only have been attained after an enormous series of attempts which failed.

We need not wonder then if, of the numerous theories which have been invented to explain the hereditary transmission of acquired characters, not one fully succeeds in accomplishing this task. If we recognise the great lacunæ existing in our biological knowledge—so that the facts often seem to us to be contradictory—it will be at once apparent that every theory which attempts to provide a complete explanation must of necessity fail. Simplicity is the defect of theories

elaborated under such conditions, and speaking generally, one may say that a theory will be insufficient in proportion as it is simple and clear. Further, these simple theories fail to provide any reason for a large number of negative examples, in which, however, all the conditions supposed by the theory to be necessary and also sufficient can be observed. In the particular case of the hereditary transmission of acquired characters the greatest difficulty confronting the simplicist theory is this: that although the mechanism of such hereditary transmission is explained even brilliantly, yet this transmission occurs so rarely and so irregularly that some of the most able biologists go the length of denying it altogether. Before, therefore, attempting to construct any theories, even generic, it will be useful to try to determine the fundamental conditions with which the theories must correspond, the lines along which analytical research and theoretical synthesis must be directed. From the sum of these enquiries it may some day be possible to build up a complete doctrine with regard to heredity and to life.

One of the generic, fundamental, conditions with which any theory of the hereditary transmission of acquired characters must correspond, is this: it must explain how a modification of the body, determined by external causes, leads to such an alteration of the sexual elements that, because of it, the development in successive generations becomes so altered as to reproduce exactly the original modification of the whole organism, and in such a way that it is perpetuated by hereditary transmission.

This fundamental condition is sufficient to lead to the rejection of the great majority of the theories on the hereditary transmission of acquired characters. According to these theories, a modification X is produced in the sexual cells corresponding to a modification A of the organism which has been determined by the action

of the environment on the tissues of the body, and this modification X is considered to be sufficient, without any other influence, to bring about a reproduction of A in the succeeding generations. But it is not necessarily sufficient. In the new organism the most varied modifications may arise which can have nothing in common with the original modification A in intensity, in situation, or in character. It is not *every* modification of the germinal elements which will ensure that the same modification will be repeated in a new organism as was produced in the progenitor; it requires a *special modification* which may be an accidental effect of the first modification but by no means a constant one. The hereditary fixation of an acquired character does not therefore occur inevitably, but demands special co-ordinations between the alterations of the tissues of the body and those of the sexual elements, and the genesis of such co-ordinations has yet to be explained.

We can picture to ourselves the action of the somatic cells on the sexual cells in various ways: either that they exert a purely dynamic influence on the latter, or that they transmit certain materials to be stored up in them. And in the absence of concrete data, the latter of these methods would naturally be preferred for two reasons; first because it is so thoroughly descriptive, and secondly because by assuming that together with the materials which are supposed to migrate, the biological properties of the tissues in which they originated are conveyed into the sexual cells, it becomes easy to explain how the modified biological characters of the organisms of the progenitors are repeated in the development of the new organism.

According to Weismann's theory of heredity all the structural characters of the future organism are predetermined in the germ plasm by virtue of special particles which represent, so to speak, the organs and the parts of organs of the future organism. If this theory

which attributes the transmission of acquired characters to a transportation of materials be accepted, it must be assumed that *particles* representing the portions of the body which have been modified and therefore the alteration itself, will be added to the original elements constituting the sexual cells.

Darwin's theory of "*pangenesis*" was the first and and most typical expression of this conception. According to it, every cell of the organism elaborates and sets free some living particles, the "*gemmules,*" which migrate through the organism and reach the sexual cells; they are then transmitted by means of these to the embryo and distributed during development to all the separate organs, determining in them their particular type of structure, and thus transmitting the hereditary characters. If the organism is exposed to some modifying influence its gemmules will be altered and the modification will be repeated in the embryo.

The simple and provisional character of the theory of pangenesis certainly did not escape the mind of Darwin. He regarded it from the first as a means of representing the hereditary phenomena in a distinct and concrete manner rather than as a true explanation, and he took it for granted that with the progress of research a more exact mechanism, founded on facts of observation, would be substituted. And while on the one hand the advances of biology since the time of Darwin have demonstrated that the relations between somatic and sexual cells are much more complex than could have been imagined at that time, and that the phenomena of heredity are simply evidences of the mysterious interactions of a large number of factors, they have on the other hand suggested that it is probable that a transportation of materials or of modifying influences from the somatic to the sexual cells may take place.

The development of the body may be looked upon as a cellular genealogy which takes its origin from the

fecundated ovum, from which all the cells of the organism are derived by continued division. But it is impossible to imagine that all these cells are developed independently of each other in an indifferent environment, that their conditions of development are similar to those of the unicellular organisms which are distinct and autonomous in the medium in which they live, and that they are comparable to the numerous generations which arise from the repeated sub-divisions of the infusoria. At every moment during the development of the pluricellular organisms correlations exist between all the organs and between all the cells, and they manifest themselves in various ways.

Some correlations are established by means which are purely dynamic, by trophic influences which are transmitted either by means of cellular connections or indirectly through the nervous system. In order that the cellular elements may develop properly they require not only a special chemical environment which depends on the development and on the activity of all the other tissues, but also certain dynamic stimuli. Clear evidence of this fact is seen in the atrophies of neurogenetic origin.

The correlations depending on chemical action are more numerous and more complex. The physiology of the glands of internal secretion demonstrates clearly that the suppression of an organ (the thyroid for example) robs the organism of a chemical element which is usually poured into the intra-organic fluids, and the absence of this element leads to a modification, a retardation, or an arrest of the development of all the other cellular organisms, although they always possess the hereditary potentiality of development. And, in fact, if the chemical element which is wanting is again provided for the organism, the cells can, up to a certain point, resume the development which has been arrested.

Correlations of this sort, more or less marked, may possibly exist between all the organs.

The sexual cells also exercise a similar action on many and perhaps on all the elements of the organism, in fact castration at an early age does interfere materially with development. The results produced by this operation may be slight on some tissues but they are very marked on others. Such an operation leads to the suppression of some purely hereditary characters and it imprints a particular stamp on the whole organism. The genesis of the differences existing between the anatomical structure of the two sexes may be attributed to an influence which the differentiated sexual cells exert on all the other tissues during development.

It is not improbable, therefore, that the cells of the tissues of the body in their turn exercise an analogous action on the sexual cells, and that a normal activity of the tissue cells is useful and in some cases necessary for the proper development and preservation of the sexual elements. The thyroid provides us with an example of this because it is known that suppression of this organ arrests sexual development, and condemns the organism to a state of infantilism and sterility.

A theory which sought to prove that the hereditary fixation of acquired characters is due to chemical influences exerted by altered somatic tissues on the sexual cells would of necessity attribute an enormous complexity to such action, and would be obliged to recognise the most intricate and particular correlations between organ and organ; but still it could not be rejected on *a priori* grounds.

By making use of these facts of correlation between the different tissues of the body, including the sexual, and recognising also that the proteid constituents of the cells can present innumerable and very delicate variations, which always preserve a perfectly specific character, Galeotti has combined the doctrine of the

continuity of the germ plasm of Weismann with the *pangenesis* of Darwin. He considers that this pangenesis depends on *chemical* influences. The germ plasm is the organ for the hereditary transmission of characters. It passes from the fecundated ovum to the sexual cells of the organism which is developed from it, and from these, with fecundation, to new germ cells. The hereditary characters are thus transmitted in a continuous manner through the succession of organisms. But the germ plasm in the mature sexual cells does not remain unchanged and unchangeable, absolutely independent of the remainder of the organism; it may even be sensitive to the most intimate modifications which take place in the tissues through the operation of the forces of the environment. The correlation would be determined by means of chemical elements, of specific proteid molecules which are readily modified, and which, starting from the tissues, would eventually reach the sexual cells and be fixed by the germ plasm.

This hypothesis, which probably does reflect some real side of the mechanism of heredity, shows us once more how in such a complex problem which might well be spoken of as the crux of all biological questions, the rigid, simple, and sharply defined theoretical schemes can do little more than furnish us with a concrete intuitive concept of a solution, with the general outlines of a mechanism which really must be immensely more complicated. They have, therefore, a didactic rather than an explanatory value.

The modern teaching of Galeotti does not succeed in avoiding a fundamental defect which it possesses in common with the doctrines of Darwin and Weismann. This defect depends on the fact that it is assumed that the germ cell is constructed of a heap of particles representing all the organs of the body, thus conferring on the germinative plasm a differentiation which symbolises

that of the adult organism, and a capacity for further differentiation and modification analogous to that possessed by the organism itself. The theory of the fixation of specific proteid molecules derived from every sort of organ and tissue implies two things; first, that there is in the germ plasm a potentiality of development under the control of stimuli derived from its environment and under a continuous restraint which is exercised by the strict correlations existing between the various portions of the organism undergoing simultaneous development; secondly, it attaches to the germ a chemical, and up to a certain point, an actual morphological complexity comparable only with that of the adult organism. Now if it is necessary to admit the existence of a capacity for further differentiation in the germ cell, the hypothesis of a so minute differentiation of particles loses its appearance of probability to a large extent; the germ cell so constructed would simply be a man in miniature.

The chemical influence which the tissues exercise one on the other during the whole of life—and in all probability we may assume a similar interaction between all the tissues and the sexual cells—does not always depend on the fixation of proteid molecules; the action of one cellular element on another, even if it takes place by means of chemical elements, does not necessarily imply a fixation of these. This may occur in particular cases but without doubt the chemical influence is more frequently exerted by means of the products of cellular secretions possessing a lower chemical complexity, which form an integral part of the mechanism of the chemical exchange of other cells without becoming fixed in them; they exercise simply a dynamic action. It is therefore possible that specific chemical substances, which are elaborated in the separate tissues, exert a simple dynamic modifying influence on the elements of the germ plasm.

But, in any case, it is necessary to explain genetically how a specific correlation between the modification of the tissue and that of the corresponding elements of the germinative plasm becomes established so that hereditary transmission may take place. Such a correlation certainly cannot be universal, capable of perpetuating any adaptative modification whatever of the body. The transmission and fixation of every character demands a particular mechanism of correlation. In the course of evolution, every time that a useful adaptative modification arises, there should also appear a particular alteration of the sexual cells co-ordinated with it, a sort of specific complementary adaptation, without which the new character could not become hereditary. A genetic explanation of the acquisition of this complementary adaptation is immensely more difficult than is that of the origin of some individual somatic adaptative modification. With regard, therefore, to the heredity of acquired modifications of qualitative characters of the body—and the concept of hereditary transmission of acquired characters is usually limited to these—it may be said that the scepticism of biologists of the Weismann school is more than justified. The development of hereditary mechanisms for the fixation of such adaptative variations may be possible but it is extremely improbable. It is far more likely that the acquisition of new characters which are produced by the qualitative differentiation of the tissues, by qualitative changes of organs and of particular properties of cells, is due not so much to a direct adaptation which has become hereditary as to the selection of fortuitous variations depending on alterations of the germ. This is admitted by Weismann.

Modifications of any of the somatic tissues may arise indiscriminately throughout the organism as the result of the action of some external cause. And the germinal elements may be altered in the same way. But it is also

possible that the change produced in these cells may be so slight as to be almost imperceptible. These slight imperceptible alterations however, by exerting an influence on the subsequent development of the somatic cells, can give rise to new characters which may be sometimes useful, sometimes injurious, and sometimes neutral in their effects. The action of natural selection will make itself felt in such cases and the injurious variations will be eliminated. It is in this way that the formation of new characters takes place; they are *acquired*—using this term in its broadest sense—but they are hereditary from the first because they depend on a modification of the germinal elements which is transmitted to succeeding generations through the continuity of the germ plasm.

At the same time this does not necessarily imply that no value whatever should be attached to the hypothesis of the hereditary transmission of what are strictly speaking acquired characters, that is to the hereditary transmission of adaptative characters which are produced in the somatic tissues by the direct action of external agents. Although such an hereditary transmission may seem highly improbable as far as the *qualitative* variations are concerned it is quite likely to occur in connection with *quantitative* variations in the development of the tissues; these variations have an enormous adaptative importance and can exercise an immense influence on the morphology of the organs and therefore on the differentiation of the species.

The adaptations have not all the same importance nor are they all produced by the same mechanism. There are many which consist in the acquisition of a special, definite, and invariable character which corresponds with a particular but permanent need and with it alone. We have already seen how difficult it is to explain the origin of such modifications—which generally consist in qualitative changes in the tissues—by a direct adaptation and the hereditary transmission of the acquired character.

It is preferable to attribute the genesis of these adaptations to fortuitous variations and selections.

But there are also generic systematic adaptations which vary according to the needs of the organism and consist in a potentiality of adaptation, in a capacity to regulate the physiological activity to the needs determined by the environment rather than in a fixed adaptative character. Moreover an anatomical variability will be found to exist corresponding with this functional variability; a capacity for functional hypertrophy is thus obtained.

Adaptations of this kind represent an enormous advantage for the organism because they raise so much the coefficient of individual adaptability to varying conditions, and, on the other hand, they do not impose an absolute obligation on the organism, they do not embarrass it with the necessity of crystallising itself into morphological modifications which are unalterable or can only be altered with great difficulty, and which might become a useless or even an injurious incubus if the conditions changed. If, therefore, certain organs or tissues are subjected to a permanent increase of work by some fixed change in the environment and undergo a lasting hypertrophy, not only will it be advantageous for the species that the capacity for functional hypertrophy should be preserved in successive generations, but it will be also useful if the antecedent hypertrophy leads to a congenital increase of the mass of the organ which will constantly leave a margin for any ulterior progress. In other terms it is useful that the functional hypertrophy should be reflected on the elements of the germ plasm, and thus determine in the species a fixed hypertrophy of the interested organ, which will render it independent of the co-operation of the external factor which produces the overwork.

The transformation of the functional hypertrophies into normal stable growths of the organs in successive

generations is not so difficult to explain genetically as the hereditary transmission of acquired qualitative somatic characters. It is sufficient to assume that a generic correlation is established between each tissue or each organ and the corresponding elements in the germ plasm. According to Weismann's conception of the constitution of the germ cell it would be necessary to assume a sort of trophic action on the part of every portion of the organism on the specific particle which represents it in the germ plasm. But independently of this and rejecting the hypothesis of such a complex and minutely differentiated germ plasm, it may be admitted that every organ and every tissue exercises a specific and continuous dynamic influence, proportionate to its mass and to its physiological activity, on the constitution of the germ plasm.

One may admit that a correlation of this kind which is simple and capable of providing for the hereditary fixation of infinite adaptative variations may arise through the operation of fortuitous variations and selection, just as the generic capacity for functional hypertrophy which many tissues exhibit, must have developed. By this it is meant that such correlation is not constant for and possessed by all the tissues; it must be developed and established for those tissues especially which present an efficient capacity to undergo a direct adaptative modification, a capacity for functional hypertrophy under the influence of external stimuli.

From every point of view therefore the *Darwinian* factor, the natural selection of fortuitous variations, seems to us to be the primary cause of every adaptation, including also the phenomenon of heredity itself. The *Lamarckian* factor, the hereditary transmission of functional hypertrophies, which tends to establish directly and without an excessive destruction of life an equilibrium between the forces of the organism and

those of the environment, supervenes secondarily as a late and most complex acquisition in the evolution of life.

Every correlation between the somatic and the sexual elements represents in itself an acquisition in the course of vital evolution, an acquisition which becomes strengthened by the mechanism of natural selection because it is useful. The same mechanism of selection which fixes the useful correlations must have prevented the establishment of other correlations, for which the necessary conditions might have arisen eventually, but which at the time would have been useless or even injurious to the organism. An ideal mechanism, for example, would be one which determined the hereditary transmission of functional hypertrophies and hindered the heredity of mutilations. Perhaps this may occur to a certain extent, and in any case, if it does not succeed altogether, it may be because such a complete mechanism has not been attained, seeing that the two mechanisms directed to this end do not work in perfect harmony one with the other.

If hereditary transmission is an acquired phenomenon, subject to the laws of evolution as are all the means of adaptation, it must be perfected gradually, and thus be continually rendered more stable. Uncertain at first, it will gradually become more rigid, and at last fixed. This hypothesis, which must be obvious to every evolutionist, reconciles completely the controversies between those who admit and those who deny the hereditary transmission of acquired characters. What value can be attached to the statement that to-day there is no example of the stable acquisition of new characters, when it must be admitted that the mechanism of heredity in differentiated species has been rendered rigid through many thousand repetitions in the same form during the centuries? And if useful fortuitous variations rarely

appear, it is perhaps due to the fact that each species has found a form of equilibrium which is perfectly stable even in face of all the multiform actions of its specific environment, and therefore finds no stimulus to undergo fresh modifications.

Functional hypertrophies also aim at establishing an equilibrium according to the physiological need, and therefore they will be arrested at a certain limit. If we wished to mention an organ, for which a functional hypertrophy and the hereditary transmission of the same would still be useful, perhaps the human brain would be the only one that we could find.

Considered from this point of view heredity appears to be essentially a mechanism for preserving the organism. In life everything is organised for this conservation; the biological aim of every vital phenomenon is a conservative aim. But no adaptation could be established with any security if the organic forms were not to a certain extent stable. The adaptative mechanism by which the characters of the species are reproduced, that is hereditary transmission, is of fundamental importance; it is the first acquisition of life, and it sacrifices the capacity for variation or at least tends to limit it, in order to render secure the acquisitions already made. In the early stages of life, when the adaptations were limited and imperfect, the conservation of the characters already attained must have been of more importance for the species than embarking on the uncertain paths of variation. The slowness with which the acquisition and the making perfect of the mechanism of heredity have been developed has provided ample opportunities for variations to manifest themselves, but the field for this must constantly have become more restricted.

Other fundamental phenomena of life may also be considered as being directed to the same end.

two cells which come from two different individuals, tends to fuse the characters of both, and it may very well be that the biological aim is to oppose any variation which might tend to lead the individuals back to an earlier type of the species. We find another obstacle to variation in the numerous means which are directed towards protecting the germ from the influences of the environment, and fixing hereditarily the conditions under which it must develop. It is probable that the phenomenon of death has no other biological aim than to restrict individual variability. In the earliest epochs of biogenesis it must above all have been beneficial to entrust the continuation of life to a careful reproduction rather than to a prolongation of the individual life, which offers, by reason of its duration, opportunities for non-adaptative changes, which would be fatal to the life of the individual and of the species. The duration of individual life has been progressively extended in proportion as the danger of variation has diminished as a result of the lessening of the organism's capacity for modification and the increased perfection of the mechanism of hereditary transmission.

Taking everything into consideration, therefore, we may conclude that in all probability the capacity for variation has progressively diminished in the course of the evolution of life. Every species may be said to have advanced far towards reaching a fixed and unchangeable type in which the mechanism of heredity is more or less perfected. And if the species have not yet reached this final form it is because nothing in life is perfect and because evolution is always going on.

Turning now to the question of pathology, it is evident that if what has been said above regarding the heredity of acquired characters is admitted, pathological lesions will be in an unfavourable position compared with the useful modifications of organs. The mechanism which

fixes the latter hereditarily can be developed in the course of evolution, but this cannot be done for the former which are accidental and individual; it is indeed more probable that mechanisms are developed which hinder their fixation. And if, in spite of all, a mutilation does succeed in exerting some influence on the sexual cells and in determining a malformation of the corresponding organ in the descendants, it cannot be admitted that this effect is due to a normal functional action of the mechanism of heredity, but rather to a pathological disturbance of such a mechanism. This false heredity should therefore be included in the concept of degeneration.

The genesis of degenerative variations may be attributed to the direct action of external influences on the sexual cells as well as to an indirect action of the altered somatic tissues on those cells. This direct action, to which Weismann attaches so much importance in regard to the genesis of fortuitous variations in general, must without doubt occur very frequently in pathology. Many degenerative alterations in fact must be considered as fortuitous variations of this kind, which are likely to be injurious rather than useful to the organism. But there is an immense difference between the useful and the injurious variations in respect to the preservation of life and to hereditary fixation.

The useful fortuitous variations, by favouring the preservation of the individual, offer an opportunity for a repetition of the same external influence on the descendants, and this will always act in the same direction. And as the individuals that are benefited by the variation survive and have a better chance to reproduce themselves, it is natural that the modification of the sexual elements which gave rise to the variation should rapidly become general, and the acquired character a normal character of the species.

The injurious fortuitous variations, on the other hand,

can, if they are grave, compromise the vitality of the individual from the beginning, and thereby be spontaneously eliminated without ever succeeding in penetrating into the mechanism of reproduction. And if they are compatible with life, although deleterious to it, they must, as constituting a disadvantage, give an opportunity for the operation of selection, which will constantly tend to restrict the number of the individuals which exhibit them. The crossing with normal individuals must also tend to eradicate the variation. In any case, in order that they may be transmitted unaltered to succeeding generations, it is necessary that the fundamental processes of material exchange be not impaired, and that the mutual dependence between the various parts of the organism be not disturbed, otherwise the injurious effects will rapidly increase.

Let us suppose that an external influence produces a modification X of the sexual cells of an organism, and that this modification X gives rise to some somatic alterations A in the offspring, which are sufficient to disturb metabolism. In this case the sexual elements of these organisms would exhibit not only the modification X through the fact of the continuity of the germ plasm, but would undergo a fresh change Y because of this disturbance of material exchange which is connected with the alteration A of the somatic tissues. This multiplication of effects can manifest itself through several generations, and these will therefore exhibit irregular fortuitous variations from generation to generation, which will gradually become more grave. And nothing is more probable than that this sooner or later will compromise the vitality or the reproductive capacity of the organisms irreparably, and will put a stop to any propagation. In that case the progressive degeneration in succeeding generations, which Morel maintains is the ordinary course of events, will assert itself.

It is clear from all these reasons that the injurious fortuitous variations which we call degenerative, do not tend to be perpetuated, but are likely to be eliminated in the progeny by different mechanisms.

If this be granted, we cannot consider the phenomena of degeneration as strictly hereditary. We have rather to deal with accidental external causes which determine a real *disease of the stock,* and produce injurious evolutive aberrations and constitutional weakness of certain systems of the organism. These then during the life of the individual offer in their turn a favourable soil for the action of other external agents, and become predisposing causes to disease.

Heredity therefore, if it comes into play at all, acts in a direction which is distinctly opposed to degeneration. Degeneration is a disturbance of physiological hereditary transmission, it is a *disease of the hereditary mechanism.* But the organisms react against disease, and if they do not succumb they tend to recover. And in fact it must be admitted that the safety of the stock depends on the mechanism of heredity, even when external influences have altered it and caused it to degenerate. In some degenerate individuals the disturbances are so grave as to cause death or at any rate to immensely diminish their vitality. In others there is an interference with the reproductive apparatus which renders reproduction impossible, and sterility is the result. But if this mechanism remains capable of function and the injurious influences from without cease to act, it tends to regain its equilibrium and to bring back the species to the normal type, to regenerate it. And really it is not a rare occurrence to see robust individuals spring from a marriage of weak individuals when the conditions of life are favourable. This has been proved even in cases of idiot women, who, having been exposed to the savage brutality of degraded beings, have given birth to normal

offspring. Degeneration therefore is a disease of the stock, but it is a disease which is curable.

The relations which exist between the anomalies in general and *atavism* can also be explained by what has been said above. The anthropological school has attached the greatest importance to these relations. It has felt constrained to demonstrate that the anomalies are really examples of atavism, that they indicate a return to forms which have been passed through in the course of phylogenesis. The frequency of the phenomena of atavism has been enormously exaggerated; even epilepsy was reduced to the formula of an anomaly, and it was assumed that in the somatic dystrophies of epileptics we were dealing with so many atavistic characters. But atavism must remain a sterile formula unless it succeeds in explaining the genesis of the conditions under consideration. It is necessary to inquire whether the returns to atavistic forms must be regarded as a normal fact in the mechanism of heredity; whether the aberrations obtained in this way represent a simple example of the variability of the species; whether the anomalies are abnormal types in so far as they are inferior, or whether they are not rather a pathological product, the result of some morbid process.

The lively polemic which arose between C. Vogt and R. Virchow with regard to the interpretation of cranial anomalies is well known; the former maintained the atavistic hypothesis, the latter the pathological. Fundamentally the question depends on the presupposition of a purely physiological atavism, while as a matter of fact the most grave doubts must be entertained with regard to the existence of such an atavism. Time has decided entirely in favour of Virchow, and it is now possible to understand that the most characteristic malformations, which had been considered to be an expression of an

atavistic freak, are nothing more than pure pathological products.

The pathological explanation of atavism is quite simple and clear. Morbid causes, injuring the organism in the course of development, may limit their action to a retardation or a general or partial arrest of development of organs. The last occurs most frequently; and even when the whole organism feels the effects of the pathological process, some organs are always more affected than others. The arrests of development resemble to a certain extent forms which have been passed through in phylogenesis for the simple reason that embryological development has, speaking broadly, some similarity to phylogenetic development. Modern embryology is very far from affirming, as is so often done by certain popular teachers of science who are burdened with undigested ideas of evolution, that the metamorphoses of the organism in individual development faithfully copy step by step the metamorphoses of the species during the course of evolution. This assumed parallelism has constantly undergone more and more restrictions, many of which are of fundamental importance. Still it must be admitted that there are certain analogies, and that these may constitute a striking feature in the case of an arrest of development.

In the instances of atavism, however, we never meet with a general and uniform arrest of somatic and psychic evolution which would justify the assumption that there are any constant correlations between the arrest of development of a given organic system and that of all the others. The morbid cause can act in different periods, and may influence in all of these some organ which is passing through a critical phase of development. And further, it may act selectively and therefore in a limited manner. It follows that the atavistic malformation of one organ need not necessarily be accompanied by analogous malformations in other organs, and there-

fore a hypospadias, for example, may quite well co-exist with a perfectly normal development of the brain.

But to return to facts. The aberrations which can lay claim to such an origin are really very few. It is the zeal of the neophytes of a facile and noisy science which has multiplied the most marvellous observations and interpretations, carrying superficiality of comparison to the verge of absurdity. I will cite as an example the famous case of a tail occurring in man, but as a matter of fact this appendage did not correspond to a tail in situation, in form, or in structure. It was nothing more than an abnormally large growth of hair in the lumbar region connected with a trophic disturbance of a clearly pathological nature, namely, a malformation of the lumbo-sacral cord.

The great majority of the anomalies, and especially those which determine morbid predispositions, do not possess any atavistic character. What atavistic character can be assigned to a congenital weakness of a particular system of neurones, a weakness which, at a certain period of life and under the influence of some trifling cause, would determine their complete degeneration? And yet we see that all the juvenile systemic diseases of the cord, of the cerebellum, of the peripheral nerves, of the muscles, with which are associated particular psychic deficiencies indicating some other lesions of the brain at present little known, belong to this category of facts. Amaurotic family idiocy also and certain forms of precocious mental weakness of infancy, and perhaps also the entire picture of dementia precox, may be only the expression of a congenital weakness of certain systems of cerebral neurones.

Moreover, what atavistic signification can be attributed to certain disturbances of material exchange, to the anomalies, to the feeble conditions, and to the functional insufficiencies of special viscera? What, for example, to the dystrophies of the genital organs? The fact is that

all the anthropological metaphors, all the laboured attempts to interpret these conditions from the onto-phylogenetic point of view, are simply a useless diversion, which gives an entirely false impression to the concept of the anomalies. The aim of pathology with regard to this question must always be to discover the genetic mechanism according to the principles of pathology, which, as we have seen, include the whole doctrine of degeneration.

Turning again to the question of morbid heredity, we have now to consider those cases in which there is a real transmission of identical pathological characters from one generation to another, the cases that is of "*similar heredity*." Judging from the facts before us it must be admitted that such a form of pathological heredity has really a much more restricted application than is generally believed. Naturally all the cases in which the presumed hereditary influence consists in a transmission of morbid germs, in a direct contagion such as occurs through syphilitic infection, must be excluded from the field of heredity. So also will those cases in which similar conditions of environment have acted in the same way on successive generations, and determined identical morbid results, fall outside the limits of heredity. This last exclusion, however obvious it may be, is not superfluous, because some authorities still speak of an hereditary transmission of pellagra and of cretinism. This is equivalent to admitting the organic hereditary transmission of misery or wealth, of ignorance or culture, of language or religion.

In mental pathology a similar heredity cannot be maintained with any force excepting in the case of hysteria, dementia præcox and the so-called manic-depressive psychosis. These three affections differ profoundly from one another, and their intimate origin is completely unknown. They are three affections,

however, we may note in passing, which do not exhibit any atavistic character, but they do lead to aberrant types of personality, which are clearly pathological, and of which not the least sign of an equivalent can be discovered either in the evolution of the species or in that of the individual. We must therefore place some restrictions on the value to be attached to this hereditary transmission.

Among the most probable hypotheses in connection with the pathogenesis of hysteria is one which represents this disease as a simple exaggeration of certain psychic characters of the female sex, and recognises therefore in the subjects of hysteria a certain affinity with some extreme types of normal personalities. If this be admitted, the mechanism of hereditary transmission of hysteria must to a certain extent coincide with that of ordinary physiological transmission. The heredity of hysteria would be explained in the same way as the heredity of certain minute personal or family peculiarities of psychic behaviour, of habits. It must also be mentioned that the hereditary tendency to this disease is rendered more obvious by the results which are produced by influences acting after birth, by the effects of example and of upbringing. Hysterical subjects are easily affected by their environment, especially in an unfavourable direction, and nothing awakens and develops the germs of a latent hysteria more than continuous association with hysterical people.

The restrictions which must be placed on the hereditary transmission of dementia precox are of a very different order. This disease, as we shall see, can be compared—at least as far as concerns its internal factor—to the weaknesses, to the congenital tendency of certain systems of neurones to fail. We have observed how this tendency to fail, and the systemic affections which result from it, may be an acquired condition dependent on the action of some external influences, which attack

the organism during the course of its development. This fact raises the suspicion that this variety of hereditary transmission has closer relations with the mechanism of degeneration than with that of heredity properly so-called. And the fact that this morbid heredity does not possess the regular and inevitable character of the physiological heredity confirms the suspicion.

The same may be said for the manic-depressive psychosis. This form of mental disturbance is characterised by the alternation, with or without intervals during which the patient returns to the normal, of the two opposite syndromes of affective exaltation and depression, of mania and melancholia. These syndromes, on the other hand, may occur apart from one another, and further they may appear simply as symptoms in the course of different diseases which are undoubtedly provoked by external causes. The whole morbid picture may spring up for the first time in a subject who previously has shown no sign of mental disturbance, as the result of some grave change which has affected the organism, through an injury, or because of an increase of intensity in the process of senile involution. In this case also the affinity with affections which are provoked by external agencies is evident.

It should be mentioned also that in dementia præcox and in the manic-depressive psychosis the heredity is more often observed among collateral branches than in direct descendants. And collateral heredity, even when it manifests itself in the most complete form of family affection, is best interpreted as a degenerative phenomenon due to the action of external causes. If a morbid condition permanently exists in one of the progenitors, it is natural that it should make itself felt by producing identical effects in all or in most of the descendants.

Putting this on one side, and considering only the similar heredity in the direct line, one may be permitted

to offer an interpretation which approximates the mechanism for the transmission of this form to that which hands on a degenerative process, although it does possess some characters in common with hereditary transmission.

There is no hereditary disease which is perpetuated continuously in a way at all resembling the transmission of a specific morphological or physiological character. In the course of a few generations a disease may appear at a certain point and may be repeated for some generations, but in the end it becomes extinguished. Now it is possible to imagine that the appearance of the disease is due to some morbid external cause which injures to a trifling extent the mechanism of reproduction in some particular, and impresses an infinitesimal modification on the material which carries out the hereditary transmission of some characters. If the lesion so produced is circumscribed and does not impede the phenomenon of fecundation and the subsequent complete development of the germ, it may determine in the offspring some little aberration which will furnish an organic basis for a mental disease. Further, the new sexual elements of this diseased organism which are derived by scission from those of the progenitors, may bear the same defect, to a greater or less extent, and may give rise to the same disturbances in the descendants, until it is eliminated through the mechanism of regeneration either by crossing or by selection.

Considered in this way the morbid phenomenon is not comparable to an acquired character which positively impresses itself on the mechanism of heredity, but is rather the expression of a defect, of a lesion of the mechanism of heredity, which repeats itself as a morbid fact until it is completely eliminated by a re-establishment of normal relations among the reproductive elements.

We therefore have to deal with a pathological process

which persists through a certain number of generations, but owes its origin to an external cause and ends in recovery.

The causes of mental disease do not therefore differ essentially in any particular from the causes of other diseases; their action, however, is much more complicated. The connection between the morbid cause and the cerebral lesion is very difficult to trace because of the complexity of the mechanism by which it reaches the brain.

Popular ideas on this subject, and these have been more or less reflected in scientific opinions for a long time, have gone too far in two opposite directions; in the first place by attaching too much importance to the so-called psychic causes which as a matter of fact are the most insignificant, and in the second place by exaggerating the value of the internal factor, they have made it appear as though the external cause was simply an incident which revealed a fatal predestination.

We have seen, however, that if our observations are extended so as to include not only the patient's organisation but also that of his ancestors, the anomaly is simply the result of the marked effects produced by an external cause which acted on it directly or through the organism of the progenitor during development. Degeneration, looked at from this point of view, is a disease of the stock and may be recovered from by means of the inverse process of regeneration. The mysterious process of similar heredity itself can be attributed to the same mechanism.

The mechanism of hereditary transmission—contrary to the biblical legend—is free from every blemish. It tends to transmit unaltered the products of biological experience and the adaptations which have been acquired

throughout the whole of the evolution of life. External influences alone are capable of disturbing it or of giving rise to disease. In every instance therefore, be it a single individual or an entire stock which is affected, the inquiry into the cause of the mental disease must attempt to reconstruct the whole complex series of steps which leads back from the symptoms to the primary cause, the external agent.

VI. Nosological Problems

The fact that the relationship between the causes and the symptoms of mental diseases is a variable one becomes increasingly clear as our knowledge of the causes of mental disorder and of the mechanism by which they lead to an injury of the brain and to a disturbance of its function, progresses.

The same cause can give rise to a variety of groups of symptoms. Alcohol, to return to a most striking example, can determine a number of diverse morbid conditions, acute, subacute and chronic, which it would be very difficult to associate together unless it was known that they depended on the same cause. Diverse causes, on the other hand, can give rise to very similar if not absolutely identical morbid pictures, so similar in fact that it is not possible, with the means at hand for diagnosing psychopathic phenomena, to decide on the cause which determines them. The picture of hallucinatory confusion, for example, may be produced by the most various causes, by alcohol as by pellagra, by uræmia as by influenza, and the differential diagnosis, whatever may be said as to the generic prevalence of certain symptoms in each group, has to be based on data obtained in the history of the disease, which enable us to learn the cause which has been in action.

The differences in the results of the action of one and the same cause depend not only on the particular reactivity of the various organisms—and these often possess certain characteristics peculiar to the individual—but above all on the diverse ways in which the cause may act. They will vary according to the intensity and the duration of the cause and according to whether it injures

the nerve elements directly or involves other organs, a disturbance of whose functions will react on the brain. Further, the mechanism through which the morbid agent acts may vary as much as the causes do.

The resemblances among the morbid effects produced by different causes depend on the fact that the pathogenetic mechanism is the same in the various cases. Symptomatology is decided, in the first place, by the *localisation* and the *intensity* of the pathological stimulus. The effects produced by the stimulus will in the majority of instances depend on the two elements of localisation and intensity. Toxins differ in their action because they possess diverse selective affinities and different degrees of intensity, but the results always oscillate between the two extremes of excitement and paralysis. A strong chemical stimulus, whose action passes rapidly through the three phases of stimulation, exhaustion and paralysis, produces the same functional effects as a mechanical force which lacerates and interrupts a path of conduction or destroys a source of energy.

These laws may be applied to the whole of the nervous system, and therefore the same relations between symptoms and causes exist also in the field of neuropathology. The same morbid process gives rise to the most diverse symptoms according to its localisation, according to the bundles of fibres or the groups of nuclear cells which it irritates or destroys. And conversely, whatever be the cause which irritates or destroys a given nervous organ, the symptom complex produced by it will always be the same.

The value to be attached to morbid symptoms and syndromes from the point of view of classification, will therefore be easily recognised. An isolated symptom indicates nothing more than the disturbance of a definite function. When we have collected sufficient anatomical and physiological data it will be possible from the symptom to determine the localisation and perhaps the

intensity of the morbid action, but we shall learn nothing concerning the nature of the agent which determines the symptom. *Syndromes* are groups of symptoms associated together by some common factor in the anatomical, physiological and pathological conditions. They provide evidence of the same kind but more precise and more in detail; and as they represent a more complex and synthetised result of the action of the morbid agent they can also give some indication of the quality of the agent. Anatomical or functional interruption of a nerve path is manifested symptomatically by a definite paralysis. This symptom itself indicates the existence of some interruption but not its exact situation; it may occur with equal probability in any part of the course of the nerve path. If, however, two nerve paths cross at any given point of the nervous system and are separated in all the rest of their extent, it is possible, it is true, that the simultaneous paralysis may be due to two independent lesions, but it is much more probable that it is the result of a single lesion at the point of crossing. This probability will be much increased if three or four symptoms may be referred to the single injury. The association of the symptoms, that is the syndrome, indicates therefore exactly the point at which the lesion has occurred. A paralysis of the nucleus of origin of a motor nerve is accompanied by atrophy of the paralysed muscles and by peculiar modifications of their electrical excitability, which are absent when the lesion is situated higher up, in the cerebral centres and paths. In this case also the association of certain symptoms, the physio-pathological result of a given injury, allows of a precise diagnosis of its localisation. Lesions of nervous organs which lie far apart, may be determined simultaneously and independently by different causes, but it is much more frequent to find that the association of symptoms depends on particular selective affinities of one general cause, the qualitative nature of which is revealed by means

of this association. Progressive blindness—due to atrophy of the optic nerve—and loss of the patellar reflex undoubtedly occur separately as the result of different causes, but their association suggests the action of a tabetic process, the late result of a syphilitic infection. I make use of these examples taken from neuropathology because they are so simple; but the same laws hold good in psychiatry, because the brain—in spite of the greater complexity of its anatomical structure and functional inter-relations—behaves like all other nervous organs when attacked by morbid agents.

Psychological observation of diseases of the mind, which for a long time was the only method employed in psychiatry, has revealed to us, besides a large series of isolated symptoms, numerous mental syndromes, which are characteristic of special conditions and consist in coherent groups of symptoms. I will mention just a few. The syndrome '*melancholia*' is characterised by a general depression of the affective tone, by the limitation of thought to a narrow circle of sad reflections, by a pessimistic view of external realities and of the personality of the patient himself, by delusions of sinfulness, of ruin, of unworthiness, etc. The syndrome '*mania*' consists in the exact opposite of this. It is characterised by a sense of well-being, of satisfaction, of optimism, by activity of movement and of ideation, by a rapidity of association which may be disconnected, disordered and futile, by the facility with which the patient is distracted by the least thing, by the instability of his will-power. In the syndrome of *dementia* we see the progressive loss of the store of memories and cognitions, which proceeds from the complex to the most simple, from the recent to the remote; the power of attention is weakened, and also the readiness of perception and the interest in external events. The syndrome met with in the condition of *hallucinatory confusion* is characterised by a grave

disorder of association, so that the attention cannot be fixed at all, and the patient is incapable of a regular reception and correct elaboration of external stimuli; the hallucinations and illusions complete the disorientation which may go on until all idea of place, of time, and even of his own personality, is lost by the patient. In the syndrome of *systematised delirium* the judgments are directed by some preconceived idea—of grandeur, of persecution, etc.—which constantly comes into play in determining the interpretation of all external incidents, produces a false impression and gives rise to errors of perception and of memory. In the *catatonic* syndrome the will is paralysed or torpid; the elaboration of any movement is impeded, every action is arrested, and the whole body assumes a fixed attitude which may be one of statuesque rigidity or waxy plasticity.

These syndromes may at times appear alone, so that each of them has been looked upon as forming a morbid entity, a disease. In other cases they form a part of some more complex diseased condition, sometimes having a permanent, at other times a temporary and fleeting existence. Because of this, and bearing in mind also the general considerations mentioned before with regard to the value of syndromes, the analysis of a morbid condition cannot be said to be complete unless the pathogenesis and etiology have also been determined. A syndrome even when it occurs in its most characteristic form and quite alone, cannot be regarded as a specific expression of a disease unless it can be shown to correspond to some specific morbid process.

The physio-pathological interpretation of the syndrome indicates nothing beyond some cerebral lesion or some functional disturbance of the psychic organ. In order that we may have a complete idea of the morbid process, in order that a conception of a disease may be substituted for that of a syndrome, it is necessary to look beyond the cerebral lesions to the organic processes which

produce them, to the primary causes which exist outside the organism. When this connection becomes known, even if only incompletely, the psychological syndromes will be regarded as of quite secondary importance, and the cerebral and extra-cerebral organic processes which form the common ground of psychiatry and general medicine, will be recognised as the important factor. When progressive paralysis became established as a separate disease on a basis of facts derived from its anatomo-pathological data, from its organic symptoms and from its etiology, the protean psychological syndromes lost much of their importance. These syndromes seemed to bring it into close relation with almost all the other forms of mental disease, so that a purely psychological examination very often led to a mistaken diagnosis.

To-day therefore all researches which aim at elucidating the objective processes forming the substratum of insanity, which attempt to interpret them according to the laws of general pathology and to discover their causes, occupy a position of the greatest importance. Pathological anatomy, as we have already seen, has, from this point of view, a double function. On the one hand it provides the interpretation of the syndromes by discovering the localisation of the nerve lesions; on the other hand, it must furnish some idea of the processes on which these lesions depend. That there is a connection between given syndromes and particular forms of cortical alterations is demonstrated especially by the investigations into the processes of dementia which have already shown that these processes possess certain characteristics in common. So also investigations regarding the acute processes which form the basis of hallucinatory confusion, have shown that, whatever may be the cause of the syndrome, whether alcohol or the poison which gives rise to pellagra or influenza, the anatomical pictures resemble each other

very closely, and the variations which are encountered are not less striking in cases which are produced by the same cause than they are in those cases which are determined by diverse causes. And the data with regard to the nature of the morbid process are no less interesting. But in this case it is the accompanying lesions of the interstitial tissues, of the neuroglia, the connective tissue and the vessels which are of importance rather than the type of intrinsic changes of the nerve elements. Moreover it is because of our knowledge of these changes that we are able to-day to differentiate anatomically progressive paralysis from all other processes connected with dementia; a well-prepared microscopical specimen will remove any doubt which may have arisen from the mere observation of the psychic symptoms met with during life.

The investigation of the organic symptoms is of the greatest importance in making a diagnosis during life; but the inquiry should not be restricted to the nervous system from which in certain diseases many valuable signs have already been obtained, but should be extended to the other systems also.

Researches on the chemical modifications of the urine, on the degree of its toxicity, on the toxicity of the blood, on the alterations in material exchange, have already provided us with an abundant literature. But unfortunately the value of the work done does not correspond with the quantity of literature produced. Many works of this sort are truly documents of sesquipedalian ignorance. The complexity and the obscurity of the questions which are being investigated, the uncertainty of the clinical criteria by which the patients are classified and selected, the difficulties of the special technique, the very frequent lack of the necessary technical skill on the part of the observers, a cause of the grossest errors, have led to the result that only very few conclusions of any value can be drawn from all this mass of work. It is a

work which must be done again, and in doing it not only must advantage be taken of the increased knowledge of biology and of general pathology, but the most rigorous care must be employed in selecting the cases which are to be submitted to the special examination, and above all prudence must be exercised so that we do not venture to embark on such a difficult enquiry without having first acquired a special training and a complete command of the necessary methods.

During the last few years many investigations have been directed towards the examination of the blood and the cerebro-spinal fluid, especially from the microscopical point of view. The knowledge which we already have regarding the numerical, and above all the qualitative modifications of the white corpuscles of the blood in the course of the different infections and intoxications, and on the significance of the special granulations contained in these cells, justifies the introduction of this method in the investigation of psychiatry in order to determine the value of the collected data, from the point of view of diagnosis and prognosis. The cerebro-spinal fluid which lies in immediate contact with the mass of the nerve centres, readily undergoes chemical alteration in the various morbid processes. Inflammations of the meninges, even when so slight as to give rise to no symptoms, lead to the appearance in it of numerous morphological elements which have migrated from the blood. The presence of these elements can be easily determined by means of the operation of lumbar puncture, a simple and safe method of obtaining the fluid directly. This method of examination has already given valuable assistance in the diagnosis of doubtful cases, and at the same time it has furnished data of the highest interest. Researches of this kind cannot be too much cultivated because they will certainly add much to our knowledge of the organic processes which form the substratum of mental diseases.

In spite of the numerous and extensive lacunæ which we still have to regret, the increased clinical knowledge of symptoms, and above all of the course and the terminations of mental diseases, the new anatomo-pathological data, and the more exact appreciation of the value of the separate causes of disease, enable us to-day to outline pretty clearly certain morbid pictures, certain types of mental disease, not only from their symptomatic side but also from that of the morbid process. Certain forms of idiocy, cretinism, alcoholism, progressive paralysis, and senile dementia are mental diseases of whose legitimate claim to be recognised as clinical entities there can no longer be any doubt. These morbid processes which are better known, serve as a starting point for the clearer elucidation of other morbid conditions. Every one of them may be said to constitute the nucleus of a group of forms which are still imperfectly defined and which must be made the subject of a more accurate analysis.

Here, however, we can only hint at a few of the more important details connected with the principal questions which are being discussed at the present time with regard to the constitution of the different types of mental disease, and to the data and the hypotheses on which they are based.

The question as to what should be included under the term *infantile cerebropathy* is very important. At one time all the morbid conditions of psychic deficiency, whether congenital or acquired in early life, were divided, according to their gravity, into the two large groups of imbecility and idiocy. The principal criterion, one however not always decisive, which was employed to assign a case to the one or the other category was the presence or absence of speech. All cases of deficiency were then considered to be the lowest expression of human degeneration, the product of the here-

ditary accumulation of somatic and psychic decadence. Later anatomo-pathological investigation, especially the work of Bourneville, revealed in these patients and especially in the more grave cases, a number of coarse lesions of the brain, most of which could be seen to be the result of an early but acquired lesion, following some infantile cerebral disease. These cases were distinguished from the others in which, at least from a macroscopic examination, no evident pathological conditions were to be detected. So, for example, a spurious microcephaly, due to an acquired cerebral process, was distinguished from a true microcephaly, an anomaly of the atavistic type, in which the brain resembled the pithecoid forms, both in its diminutive size and in the simplicity of its convolutions. Other distinctions were made on the clinical side. Thus Sollier separated the imbeciles from the idiots not according to the gravity of the deficiency, but according to the qualitative differences in the characters of the mental disturbance. Idiots were those who suffered from some real disease, but who were capable of being educated in spite of the gravity of their deficiency; the imbeciles were degenerates, who were psychically perverse and incorrigible.

Knowledge of the infantile cerebral affections has increased also from the point of view of neuro-pathology. Many of these conditions exhibit striking motor symptoms, accompanied by atrophies and contractures, and by a large number of other nervous symptoms. In these cases the psychic deficiency, which sometimes is really very slight, appears rather as an accessory condition of secondary importance. On the other hand, neuro-pathologists must recognise that there are some cases in which the motor disturbances are unimportant or even absent, and the signs which can be discovered by a neuro-pathological examination of the brain are very few, whilst at the same time the psychic symptoms and the cause of the process support the idea of a cerebral

lesion. These are the cases of so-called cerebroplegia without paralysis of Freud. The diversity of the symptoms in the various types of cerebropathy must naturally be attributed to a difference in localisation of the morbid process.

By making use of psychological, anatomical, and neuro-pathological data, Tanzi has been able to divide patients suffering from some deficiency into two classes. In one of these the data regarding the etiology, the presence of paralysis, convulsions or of other disturbances of motility even if only very slight, and a peculiar irregularity in the characters of the mental deficiency, suggest a cerebropathy. In the other class the absence of any trace of motor symptoms, the general harmonious character of the psychic disturbance together with the greater prevalence of perversions rather than of deficiences, indicate a congenital or perhaps an hereditary anomaly.

This distinction is sufficiently clear when the differential characters are well marked, but its application is not always easy. This is not to be wondered at if we remember the meaning which we have already attached to the term anomaly. If a morbid agent acts on an infantile brain which is free from any predispositions and injures it to a grave degree in a circumscribed area, we have a typical case of cerebropathy. If on the other hand a more or less harmonious deviation in its development as a whole is produced by a slight cause which exerts its influence during the first stages of embryonal development, or better still on the sexual cells while they are isolated in the bodies of the progenitors, the result will be a pure anomaly. But it is possible to trace a whole series of intermediate forms between these two types; and if the dualistic concept is justified by the fact that the functional disturbances and the anatomical alterations in the different cases tend to develop in opposite directions, the theory of the

unicists is supported by the gradual passage from the one series to the other, and by the fact that in any case there is no essential difference in the etiological factor, because in both instances we have to deal with a morbid cause of external origin which exerts its influence on the organism at a more or less early stage of its development. For this reason Tanzi holds that the old unicism, which is founded on degeneration and heredity, may in time—when in every case an organic lesion can be demonstrated—be succeeded by another and contrary idea of unicism, in the sense, that is, that it recognises a cerebropathy in all these cases, and he suggests that the term imbecility should be applied to the slighter forms. The two concepts, unicist and dualist, do not necessarily contradict each other because they regard the same subject from different points of view. Unicism seeks to discover the fundamental resemblances in pathogenesis and etiology, while dualism draws our attention to the two extremes towards one or other of which all the various forms tend to group themselves.

This theoretical question occupies a more secondary position when an attempt is made to establish further distinctions, more detailed relations between the anatomo-pathological forms and the clinical pictures. In the field of evident cerebropathic conditions we find that we are confronted with the most profoundly diverse pathological processes. There are some lesions which are the result of the occlusion of vessels and of a localised destruction of portions of the brain; others are due to injuries of the encephalon at the time of birth or to asphyxia during birth. Other lesions, more or less diffuse, are due to a meningo-encephalitis occurring at an early stage in the development of the embryo, or to hydrocephalic conditions in which a localised lesion has led to a disturbance of the formation and circulation of the cerebrospinal fluid and produced

an accumulation of this fluid which causes deterioration and atrophy of the brain. There are also fine diffuse conditions, not visible to the naked eye, which are determined probably by a general infection, or by a brief intoxication which gave rise to a hyperplasia of the neuroglia at the expense of the nerve elements. In other forms again, appearing often in various members of the same family, the interstitial elements are unaffected while the cortical neurones undergo a primary degeneration which is dependent on a condition of congenital weakness; and there are many other obscure forms the mechanism of which it is at present impossible to explain.

Up to the present the attention of investigators has been directed chiefly to the gravest types, but there is no doubt that some of the less marked forms may find their origin in these same causes. Now it must be asked whether pathological anatomy cannot reveal even in the cases which are usually considered to be simply degenerative or congenital, or as due to some anomaly, some slighter forms of these same processes or of morbid conditions of some other kind which, though trifling, have a general action and involve extra-cerebral and extra-cranial organs also. Here, however, we find ourselves before a field almost entirely unexplored, but now that the methods of histological technique are such as to allow of a more intimate analysis, it becomes imperative that enquiries should be made in this direction.

Investigations into subjects in whom the mental deficiency is very slight, into the so-called deficient or backward children, would be of especial interest because they already present from the clinical and psychological sides many differentiating signs which in all probability are dependent on extremely diverse pathological processes.

We must inquire also whether the so-called normal insanity or imbecility—the *constitutional immorality*

of Tanzi—which is unanimously regarded as a typical anomaly, should not be included among the more attentuated forms of cerebropathy, or at any rate among the processes of altered development of the brain due to causes which have acted at a less remote period, and which, therefore, could not have exerted their influence through the mechanism of heredity. In many cases of cerebropathy there is a complete absence of ethical sentiments. The loss of these sentiments may occur even in adult age through the operation of the most varied processes which produce a cerebral weakness, and it would not therefore be surprising if some slight morbid agent, one which does not differ essentially from those which give rise to the coarse cerebropathies, should determine a simple perversion limited to the ethical side of the personality.

When research has sufficiently advanced in these directions it will be possible, with the help of a detailed knowledge of groups distinguished by their etiology, by the mechanism of their pathogenesis, by their clinical characters and by the anatomo-pathological process on which they are based, to combine the unicist conception of the pathogenesis of psychic deficiency and the dualist conception which differentiates serially so many forms of that disease.

The subject of *epilepsy* is closely connected with that of the cerebropathies. It has been known for a long time that epileptic convulsions are one of the most frequent symptomatic manifestations of cerebropathic processes. In the infantile cerebropathies, which reveal themselves on the psychic side in the various forms of idiocy, it is a very frequent phenomenon; it is common also in the cases in which the psychic deficiency is trifling or almost nil; it is, therefore, considered to be a sure sign of a cerebropathy. Epilepsy may appear also after cerebral injuries in an adult individual who

has never shown any sign of that kind of disturbance before. In fact, it forms one of the symptoms of almost all those cerebral affections acquired in adult life which are due to chronic intoxications, to alterations of the vessels, of the meninges, and of the neuroglia; we see it therefore in chronic alcoholism, in progressive paralysis, in the various forms of arterio-sclerosis, and of senile involution of the brain, and also as a sequel to circumscribed softenings and to the presence of parasites in the brain.

It is impossible to differentiate by their ordinary characteristics the epileptic attacks which are met with in the above-mentioned diseases from those which arise apparently spontaneously in individuals in whom there is no reason whatever to suspect a cerebropathy. At the same time it is usual to make a distinction between the first which are spoken of as *epileptiform* or symptomatic, and the second which constitute the so-called *true* or *idiopathic* epilepsy. These mystic adjectives are applied by pathologists to everything of which the cause is unknown. As a matter of fact the only criterion which distinguishes idiopathic from symptomatic epilepsy is the absence of concomitant symptoms which allow of the attacks being attributed to some very evident cause.

It is believed by many that the specific cause of *true* epilepsy is to be traced to an auto-intoxication dependent on some alterations in the processes of material change. There is no doubt that certain toxic substances, if they exceed a given grade of intensity of action, can bring about an outburst of convulsive attacks even in a perfectly normal nervous system. This can be demonstrated by the simplest experiments. But it is not sufficient to prove that toxic action is the principal and indispensable cause when there is no evident cerebral lesion. It is known that the most varied poisons will provoke convulsions much more easily if the nervous

system, and especially the cerebral cortex, presents any lesion. It is well known that alcohol possesses the power of rendering the brain more sensitive to the processes connected with the production of epileptic attacks. A cerebropathic condition, acting during infancy or a little later, may leave a circumscribed lesion which gives rise to no symptoms, but which, under the influence of alcohol or of other endogenous or exogenous intoxications, may light up an epilepsy which is erroneously regarded as idiopathic.

Clinical analysis on the one hand and anatomo-pathological investigation on the other tend to-day to prove that a real idiopathic epilepsy does not exist. Among the symptomatic manifestations which form the epileptic attack or which precede it, there are always some which support the suggestion that there is a localised origin of the outbreak, symptoms indicating the presence of a more or less circumscribed lesion, which is supposed to constitute the centre from which the stimulus for the epileptic discharge starts and spreads to the other centres.

The phenomena of the aura, all the special limited motor crises with which the convulsive attack begins, the prevalence of unilateral convulsions, are signs of this sort. The asymmetrical formation of the body which is so often met with in epileptics may be regarded as a result of the dystrophic influence which a unilateral or unevenly distributed lesion of the nerve centres can exercise on the development of the other organs. An anatomo-pathological examination in cases of presumed idiopathic epilepsy, frequently discloses the presence of even grave cerebropathic lesions, which are, however, limited to zones of the cortex that as a rule do not reveal a functional defect by any clearly marked symptoms. It may be for this reason that a sclerotic lesion of the Cornu Ammonis is so often met with in epileptics.

Nor can it be maintained from the psychological side that the epileptic syndrome constitutes a disease *per se*. A series of psychic disturbances, in connection especially with voluntary manifestations, with the affections and the character, has been described as being typical of epilepsy. Such a series is certainly to be met with but it is just as typical in the idiopathic forms as in those which are manifestly symptomatic and acquired either in early life or even in adult life, provided that their duration has been sufficiently long to allow of its development.

If, as seems likely, this view becomes confirmed as time goes on, the conception of epilepsy as a disease *per se* will disappear entirely. Epilepsy will be regarded in all cases as a syndrome which reveals the existence of an acquired cerebropathic process whose nature may vary within very wide limits. The designation "epileptic" for certain patients will still preserve some value from the strictly practical point of view, but epilepsy as a disease will disappear from our classifications.

It will at once be recognised that this view is absolutely opposed to that of the anthropological school. According to this school epilepsy would be the most typical example of degeneration due to atavistic recurrences and to heredity. Anthropology, comparative psychology and at last anatomy, have been pressed into service to explain atavistically all the psychic and organic symptoms of epileptics; and it is impossible to say how many acrobatic feats of reasoning and how many superficial deductions this theory is responsible for. On the other hand, anthropology has neglected all the clinical and anatomo-pathological facts which bring epilepsy into line with obviously acquired cerebropathic processes.

On the ground of a superficial analogy based on the turbulent character of its convulsive manifestations,

hysteria has for a long time been compared with epilepsy. Clinicians have done their utmost to discount the value of any differential diagnosis and have always retained the conviction that there exists a profound affinity between the two conditions; they have also imagined borderland cases and intermediate stages between the one form and the other. This point of view is however being abandoned gradually. At the present time most authorities accept the fact that the two conditions are essentially different; and if the association of the two symptomatic pictures in the same individual is possible, in the same way that so many other morbid associations are possible, a true fusion or a transition from one to the other must be excluded.

With regard to hysteria, now that it has been so thoroughly studied on its psychological side and also in connection with the part played by peripheral stimuli in the production of its protean symptomatology, research should be directed towards the discovery of the pathogenic mechanism. We have already seen how secondary disturbances which in many diseases develop side by side with or follow some primary disorder whose origin is to be sought in organic alterations, can be explained by psychological methods; but such an interpretation is not sufficient to clear up a whole syndrome. In such a case it is necessary to discover some objective explanation, the organic reason of the functional disturbance which forms the basis of the psychic disorders.

The psychogenetic interpretations of hysteria which reduce this disease to a simple but fundamental perversion of psychic functions, of association, of the affections, of sensibility, may be useful synthetic formulæ to explain the symptoms in simple and general terms, but they do not reveal to us, in any way, the pathogenesis of the condition. Other theories pretend to provide an objective, one might almost say an obvious, basis for the psychic disturbances—that of Sollier, for example,

who regards the phenomena of hysteria as due to a condition of sleep of some centres of the brain, or that of Lépine who attributes the hysterical paralyses and anæsthesias to the occurrence of interruptions between the articulations of the neurones produced by an active retraction of the neurodendrites. These offer merely a hypothetical explanation of the immediate mechanism of the morbid process; they give us no explanation of the pathogenesis.

Judging from the complexity of its manifestations, which may include every aspect of the personality, and from its constitutional character from the point of view of family and hereditary influences, one may, speaking generally, admit that hysteria may be regarded as an anomaly. But in what does this anomaly consist? The possibilities are numerous. It might be said that it is a very delicate anatomical anomaly which cannot be demonstrated by present means of investigation, or that it is a functional, dynamic anomaly. The latter of these in its turn may be the product of essentially different factors, a slight general modification of nervous excitability, a perversion of the functional alterations regulating the associative relations between the various neurones; a want of equilibrium between the organs on which the different psychic activities depend, for example, those of the emotions, or of the critical faculty; a functional want of equilibrium in the extra-cerebral nervous system, above all in the visceral mechanism of the emotions; slight chemical disturbances of material exchange due to causes existing outside the nervous system but capable of affecting its dynamic activity. There are in fact so many possibilities that it is difficult to decide which is most probable. Without doubt the dynamic disturbances of the functional activity of the nervous system are of great importance. This is proved by the enormous influence which external stimuli exert in the production or modification of the symptoms.

The fact that hysteria may be acquired as the result of a profound shock to the whole organism also supports this view. On the other hand the very interesting phenomenon of the appearance of hysterical symptoms as an accessory fact in organic diseases of the nervous system which may be either the effect or the cause of intoxications or of a disturbance of material exchange, shows that the hypothesis of a fundamental chemical alteration cannot be altogether ignored.

We are, it is true, altogether in the dark in regard to this question, but we must remember that the examination of the hysterical person has so far been almost exclusively limited to the psychic and nervous manifestations, which veil the true disease under a mass of symptoms; but beneath these perhaps a more definite substratum of organic alteration than is generally imagined may lie hidden.

Similar considerations may be applied to the subject of *neurasthenia*, but in it the influence of a chemical factor is perhaps more evident. There is one form of neurasthenia which appears to be an expression of a congenital constitution; but on the other hand the various symptoms of neurasthenia equally manifest themselves in states of exhaustion or of malnutrition or of post-infective intoxication, as a sequel of injuries, or as the first sign of grave generalised organic processes of the nervous system. The fact that therapeutic measures capable of acting on material exchange and on nutrition sometimes exert a beneficial influence, supports this view.

Another morbid picture that requires further elucidation is that of *amentia*. Under this title are grouped together numerous clinical cases characterised by acute mental confusion with hallucinations which are due to toxic, infective, or post-infective causes, and which after a brief course end either in recovery or in death. It is

evident that we are dealing here with a syndrome rather than with a recognised and separate disease. The symptomatology of amentia is encountered with all its characteristics in other morbid conditions which are the result of specific causes. We are accustomed to meet with instances of true alcoholic amentia, of pellagrous amentia, of uræmic amentia. Not only so, but the condition of hallucinatory confusion may arise in the course of chronic diseases probably through the action of some accessory toxic causes intervening in the course of the original disease; as examples of this we may mention the clearly amential episodes which appear in progressive paralysis and senile dementia, et cetera. It is evident then that we do not apply the term amentia to these cases because we are able to recognise a specific cause and because we regard the amential episodes as an accessory occurrence, a superaddition. In fact, we have come to include in the group of amentia only those cases in which the cause is recognised in a generic and vague manner, those cases, that is, which are connected with conditions of exhaustion or intoxication, the result of an antecedent disease. Naturally, therefore, when by a more delicate and more thorough clinical analysis we succeed in differentiating the morbid causes and in unravelling their action in some specific way by means of psychological and somatic data, the group of amentia will gradually be narrowed down and will eventually disappear altogether.

The influence of predisposing elements deserves further attention in connection with these cases; in many instances at any rate they form a not unimportant factor. Sometimes the syndrome of amentia recurs again and again, even in a periodic manner, without any recognisable cause. Other cases do not go on to recovery, but terminate in a dementia which, from the clinical side, it is very difficult to distinguish from the final stages of dementia precox. It remains, therefore,

to be discovered whether in these cases there is some internal personal factor at work or whether there may not be some nosological affinity between them and the periodic forms of the affective psychoses and dementia precox.

The *affective psychoses* themselves form a nosological group which is not yet understood. They possess as a common fundamental element a pathological variation of the affective tone which reveals itself in the two contrasted syndromes of melancholia and mania. It has been known for a long time that these two morbid pictures, while symptomatically antagonistic, are in many respects closely allied to each other, so much so that they appear alternately in the same individual, giving rise to that very singular condition of psychosis which, because of a continuous alternation of the two opposed affective states, has been termed circular. It is known also that this alternation may occur irregularly, attacks of varying character succeeding each other even after considerable intervals of time. At the same time it has been recognised that besides these mixed forms, consisting in an alternating variation of the two opposed affective states, there exist other cases in which there is a simple alteration in one or other direction, and that amongst these cases, although there is a tendency towards a periodicity or at least to frequent recurrences, there are some isolated pure forms constituted by a single attack of one or the other, of mania or melancholia. From the pathogenetic and prognostic point of view a very different value has been attached to these simple conditions. They were supposed to be dependent on accidental causes, while the periodic and circular forms were considered to be due to a true degeneration.

It is to the credit of Kraepelin that he insisted, in the most explicit manner, on the affinity existing between all these forms of the affective psychoses which formerly

had been held to differ from one another. Kraepelin has shown that the alternation of the two states may take place in the most varied and irregular manner, both with regard to the character of the attacks which succeed each other and to the length of the intervals. He has demonstrated further that many of these cases in which the attacks observed while the patient is in the asylum are all of the same type, still belong to the mixed forms, because the inverse affective state is not absent altogether but occurs with very slight symptoms in the period during which the patient is outside the asylum and is considered normal. These cases, then, pass by inappreciable gradations from the most regular forms of circular insanity to the irregular, to those in which one phase of the cycle is little marked, to those in which one phase only is periodic, to those not characteristically periodic but consisting in a few attacks occurring at irregular intervals, and finally to those consisting in one attack. Mania and melancholia must, therefore, be regarded as different manifestations of the same disease which Kraepelin, because of this promiscuity and alternation of symptoms, has called *manic-depressive* insanity. A peculiar form of melancholia, characteristic of the involutive age and tending to chronicity, provides the one exception, and to it alone should the simple term melancholia be applied.

That much of what Kraepelin suggests is true must be admitted and his views have obtained a large and ready acceptance. But there still exist some doubts as to whether such an absolutely complete assimilation is really justified. The two syndromes of mania and melancholia appear sometimes in various other diseases as pure symptoms differing essentially from the manic-depressive insanity in their cause, their course, and their termination. Melancholic and maniacal syndromes are observed in old age as prodromata to or episodes in a process of dementia; they are seen in progressive

paralysis and they may accompany certain forms of imbecility; they sometimes appear after an injury and they are met with especially in the initial phases of dementia precox. Moreover in all these instances the two forms tend to occur at intervals and in an alternating and circular manner. In senile dementia and in progressive paralysis the presence of other psychic and somatic symptoms, and even the peculiar imprint which the syndrome tends to assume, may easily, at least in a large number of cases, reveal its symptomatic nature and the character of the fundamental disease at the same time. But this is not so in dementia præcox, because in it the two syndromes may appear together at the beginning of the disease and may present themselves with such clearness as to defy all the diagnostic refinements of clinical psychology. Kraepelin himself in fact has recognised that in such cases a diagnosis is extremely difficult, and often must be suspended for a considerable period.

Now this is of considerable importance apart from the difficulties which arise in making a diagnosis, because it demonstrates that the pictures of mania and melancholia may depend on causes which are specifically different from those which give rise to the manic-depressive insanity. Probably the two syndromes may be produced by a whole series of chemical, nutritive, and dynamic actions which exert the same effects on the most intimate dynamic activity of the nerve elements, although they differ immensely in nature amongst themselves. However this may be, if it is made clear that in the great majority of cases grouped together under the title manic-depressive insanity there is a community of origin depending on some constitutional disturbance of the nutrition of the nervous elements which is frequently consecutive to a perversion of material exchange or to some extra-cerebral alteration, it is justifiable to assume that other cases which differ from the common

type perhaps only in that they exhibit a single attack which is recovered from, owe their origin to a different cause. This may be only accidental or transitory in action but the cases cannot in consequence be classed with the others. Although this is so debatable a point in connection with the syndrome of mania, it is much less so with the syndrome of melancholia, which according to general experience, has not such a tendency to relapse and to periodicity as is characteristic of the manic-depressive insanity.

These doubts will not be solved until clinical examination is carried out much more thoroughly not only with regard to the psychic symptoms, but also and especially with regard to the unknown organic cause which forms the substratum common to the two opposed syndromes. When this has been discovered it will become possible to clearly separate the various forms, and the manic-depressive psychosis, if proved to be due to a single cause, will be given a more convenient denomination than that at present in use, which suggests that symptomatically there are two entities when there is really only one, because the attacks are really all of one type.

The clinical conception of *dementia præcox* is at present the subject of much debate. The clinical picture described by Kraepelin during the last ten years, is the product of the union of various morbid pictures to which, for a long time past, alienists had directed their attention, considering them at one time as groups of symptoms and at other times as separate diseases. The first conditions described were hebephrenia and catatonia. *Hebephrenia* is characterised by its appearing at an early age, generally at the time of puberty, and by the rapid advance of a dementia which is often profound. In its first stages the disease unfolds itself with rapid and sometimes violent changes, with states of excitement

and of depression, with discordant and eccentric, puerile, impulsively violent or obstinate conduct. *Catatonia* is essentially characterised by the symptom bearing this name, which consists in a rigid statuesque immobility in attitudes more or less expressive. These attitudes are not determined, as some suppose, by psychic activities; they are derived directly from a perversion of the will and of the motor factor of expression in general. The patients feel themselves compelled to assume the attitudes referred to, and they also experience an unconquerable resistance to the execution of any other action whatever. This symptom, which may be present in various degrees and also intermittently, is accompanied by a whole series of other symptoms, which are often little evident but always affect the motor functions, for example, those of mimicking, of walking, of speaking, of writing and of every variety of action.

To these two forms of dementia præcox a third has been added later, *paranoid dementia*. This class includes those patients who are the subjects of hallucinations and of various delusions. These delusions are not coherent as are those of the paranoiacs, but are vague, futile, paradoxical, foolish. In these cases we find also a perversion of the affections and of conduct, which, because of the absence of any psychic motive, must be recognised as primary.

Kraepelin was induced to include these various forms, which in appearance are so heterogeneous, in the one class of dementia præcox because of the existence of intermediate states between one condition and another, on account of the possibility of a combination of symptoms belonging to various groups occurring in one case, and also from the similarity of the principal outlines of its course, which is usually chronic, and of its termination, which is dementia. A fundamental clinico-psychological character of this disease consists in this,

that the major alterations are connected with the will and the affections; the minor disturbances appear in the field of the associations and of the memory which however may, in some instances, be normal. The functions of sensory and motor projection are normal in every case, and, in fact, the capacity to perceive and to carry out ordinary movements is never permanently diminished. Among the various groups there are some differences in the time of onset, in symptomatology, in course, and in termination. The hebephrenic forms are those which appear first and lead to the gravest conditions of dementia. Catatonia starts later and allows of a longer preservation of the mental faculties. Last of all come the paranoid forms of dementia, in which the contrast between the disturbance of the affective tone and the will, and the relative integrity of the perceptive and associative functions may be better observed. Patients who preserve a good memory and are capable of complex and ready associations, exhibit an affective insensibility, a passivity and an absurdity of behaviour which is beyond all imagination.

The picture of dementia præcox tends to become still more comprehensive. Certain forms of precocious feebleness of intelligence, which at first might be confused with imbecility, must be considered as allied to hebephrenia. To the other extreme of the series must be added other later conditions connected with the involutive age which pass insensibly into the paranoid forms. Amongst these should be included certain states of hypochondriacal delusion associated with suspicions of persecution, and also states of affective depression with symptoms of negativism and a tendency towards chronicity and to dementia which resemble catatonia to a certain extent.

There is no doubt that all these psychopathic processes constitute a continuous series, and it would be an arbitrary proceeding to introduce sharply defined divi-

sions among them, although the cases at the two extremes exhibit such marked differences. It is justifiable, therefore, to attempt to bring all these diseases together into one clinical form at least provisionally. But psychic symptoms are not sufficient to decide this point; a definite decision can only be arrived at on pathogenetic and etiological grounds.

The question of the immediate pathogenesis of these psychic disturbances, that is, the connection existing between them and definite forms of cerebral lesions and their anatomical situation, may be said to be already partly solved. Although anatomo-pathological researches have only just been initiated and much work still remains to be done in this direction, the facts which have already been collected coincide so closely with the clinical and psychological data as to lead us to believe that in this disease we have to deal with degenerative processes which attack primarily and almost exclusively certain definite systems of cortical neurones. Signs of inflammation and primary alteration of vessels are absent, and the changes of the neuroglia are probably secondary and take place as a sequence to the destruction of the nervous elements. The lesions naturally are not equally distributed in every case, and this fact coincides with the symptomatology which varies in gravity and in extent in each case. The elements especially altered are those which establish local intrinsic connections in the cortex. On the other hand the large motor cells are normal; and this coincides with the integrity of the function of projection.

That we have to deal with a process of primary degeneration of cortical elements may be inferred from one particular of the clinical course. Contrary to that which happens in other forms of dementia in which the psychic decadence is continuously progressive, in dementia præcox we find at first a period in which the most violent mental symptoms alternate with one

another, and a psychic deficit increases gradually. Then, sooner or later, this period is succeeded by another in which the decadence is arrested; the conduct acquires a more stereotyped character, the mental capacities which are still left become organised, the irregular habits contracted during the course of the disease grow into a sort of systematised activity occupying every hour and every moment. We must admit that during the first period there is an irritative and destructive process going on, and that in the second this process ceases and there remain only some anatomical and functional lacunæ. And while in the first period the symptoms are not those of simple deficiency, but rather consist in great part in excitements and inhibitions, in the terminal portion of the disease we encounter pure manifestations of defect in a brain which has been mutilated in some essential centres, but in which the activities of the remaining normal portions have been reorganised as far as possible.

If to this it is added that very frequently dementia præcox occurs in several members of a family and sometimes is clearly hereditary, that in the majority of cases it arises without any apparent cause, there is good reason to surmise that it is the expression of a more or less systematised primary degeneration of intracortical neurones, which depends to a considerable degree on a predisposition, on a congenital weakness of these systems.

But this does not suffice to enable us to assert that we have yet sufficient evidence to establish it as a definite disease, an entity which is the result of some specific cause. We know from the study of the systemic affections of the spinal cord, of the nerves and muscles, that certain analogies between anatomical processes do not constitute evidence strong enough to prove an identity of cause. If certain processes of primary degeneration can arise without the co-operation of any

very evident external cause, there are others in which an external cause certainly intervenes, and it is to it that the process is due. Perhaps in such a case the constitutional weakness of the system does nothing more than prepare the seat of election, while by itself it would be insufficient to provoke a functional decadence or a spontaneous degeneration. It is probable in fact that such an analogy holds good for dementia præcox.

At the present time when clinical experience has so much increased as a result of the particular attention which the views of Kraepelin have attracted to this subject, it cannot be questioned that there are some forms of dementia præcox in which the early stages are interrupted by alternating periods of insanity and of normal health. And especially in the juvenile cases one might say that it is the rule to see periods of suspension, of complete remission of symptoms. In these cases it would appear that the predisposed systems of neurones are attacked by some external cause which may affect the whole organism or the brain alone, and that they have the capacity to repair the lesions and to recover their function, if the cause loses its active power and has not produced real destruction. There is no doubt, therefore, that some cases recover. Syndromes which exhibit all the characters of dementia præcox and which therefore lead us to give a guarded prognosis, if not one that is altogether pessimistic, may disappear rapidly and allow a return to the normal condition, which may be maintained during the remainder of life or at any rate for many years. At times the initiation of the disease may be attributed to a definite external cause. There is a considerable number of cases in which the process follows states of exhaustion and goes on to dementia. The puerperium and lactation are of especial importance in this connection. In other cases a confusional state sets in during convalescence from an infective disease, or after a grave surgical operation,

which at first reminds one of the recoverable forms due to similar causes that are included under the term amentia, but which very soon assumes all the characteristics of dementia præcox.

Now although the unification, or at least the association, of so many forms may be justified from the symptomatic and the anatomo-pathological side, it is not admissable from the etiological. Our actual knowledge on this subject would lead us to suggest that dementia præcox embraces a collection of closely allied psychopathic syndromes based on very similar anatomical changes; that it depends on systemic and selective lesions of cortical neurones, which however do not absolutely correspond either in extent or in degree; that the predisposition is not of the same importance in all cases, and often requires the co-operation of endogenous and exogenous causes, of different nature and efficacy. Further researches are necessary to verify the correctness of these suppositions, and to determine their importance with the view to establish, wherever possible, definite distinctions, based not only on symptomatology but also on the etiology and the pathogenetic mechanism.

Another division about which little is yet known is that of the *presenile* and *senile psychoses*. At present the senile psychoses are regarded as a result of a real disease of the interstitial tissues following vascular disease rather than as the product of a spontaneous involution of the cerebral nervous elements; and there is no doubt that this idea is right to a great extent. But certain differences in the clinical pictures justify the suspicion that the etiology and the pathogenesis are not so absolutely uniform. The fact that arterio-sclerosis may also involve other very important organs, such as the kidneys, cannot be neglected, and Tanzi has been led, therefore, to attribute the disturbances of the amential

type, which are so often seen in senile dementia, to the accompanying renal insufficiency. But it may still be asked whether primary degenerative processes or processes of simple hypertrophy of the neuroglia, which may give rise to secondary lesions of the nervous tissues, should not be recognised as well as those secondary lesions of the nervous elements due to a general defect of nutrition, the result of vascular disease. At any rate the anatomo-pathological pictures show striking differences in this respect, and it is in this direction that research should be carried out, in order if possible to isolate forms which differ not only from the symptomatic and anatomo-pathological side, but also from the etiological.

But besides this investigation psychiatry has yet to determine why in some cases the process of senility appears very early and affects one system more than another; why it sometimes attacks, apparently with some selection and in a partial manner, vessels supplying different parts; why in other cases it affects the vitality of the nervous elements directly, causing them to degenerate, or why it sometimes excites the processes of gliosis. In the field of the presenile psychoses the limits of various affections seem to meet, and it is not to be wondered at, therefore, if on the purely symptomatic side a great uncertainty still exists.

In this chapter I have briefly hinted at the most important questions which offer themselves for consideration in the field of classification. There are, however, many others besides those mentioned which it is hardly worth while to bring forward. Those cited will suffice to show how impossible it is for clinical psychiatry to progress without the combined assistance of all the means of enquiry which are at our disposal. It would be vain to seek for distinctions based on psychological observation alone. We should fall into the old errors

of mistaking simple psychic syndromes for true diseases, and of failing to recognise the close affinity of origin and mechanism which exists between the most diverse syndromes. No doubt a difference in symptomatology may suggest corresponding researches in the field of pathogenesis and etiology in the same way that differences in the anatomo-pathological findings may direct attention to symptomatic differences which have previously escaped notice; but knowledge of mental diseases, in the strict sense of the word, can only be attained by the progressive integration of psycho-pathological data with those of general pathology, etiology, physiology and of normal and pathological anatomy. The morbid pictures will gradually become better defined as our knowledge of these subjects increases and as the knowledge gained in the one is made to help in the elucidation of the problems of the others. It is only in this way that mental diseases will cease to be mere enigmas and psychiatry will become, as it ought, a recognised branch of general medicine. Until this knowledge is gained it has little right to pretend to any place in science or in the art of medicine.

VII. Practical Problems.

Recovery from disease is always the result of activities of the organism in response to abnormal stimuli. This response counterbalances the action of the pathological stimuli, eliminates their causes, and thus paves the way for a return to the normal as quickly as possible. Disease, then, is a vital reaction, an adaptation, an act of defence on the part of the organism against the environment. If this defence gains the day then recovery is the result; if not, death or physiological decadence of the organism follows.

But this defence is very far from reaching that perfection possessed by the physiological processes which are essential to the life of the organism. In disease, the reactions of individual organs, of the single parts of the organism, are not so well co-ordinated as the normal functions; and the autonomy of local reactive processes not infrequently proves disadvantageous. Tissues react to stimuli in definite ways which are best adapted to contend with and overcome the morbid cause within their sphere of action, but often the local reaction of a tissue produces collateral effects which disturb the general functions of the organism and are capable of imperilling its life or actually killing it. Inflammation is doubtless a beneficent process, but intense inflammation of the glottis may close the respiratory passages and determine asphyxia. Cicatrices are the result of a reparative process, but cicatrices of the cardiac valves cause heart lesions which may prove fatal. Fever is a reaction of the organism and is defensive, but should it exceed certain limits it can impair the great tolerance of high temperatures possessed by the nervous

system and cause death. Life then is not menaced by external agents alone, but also by the immoderation and want of harmony of certain reactions, by certain symptoms whose effect is in excess of the original intention.

In no case does the treatment of disease determine its cure. This occurs spontaneously through the hereditary adaptive properties of the organism. Treatment favours recovery or renders it possible either by eliminating the causes of the disease or by reducing the excessive action of certain symptoms which, by completely interrupting any curative tendency already established, might lead to a fatal result. From this point of view the treatment of the symptoms is not by any means of less importance than the treatment of the cause. Other forms of symptomatic treatment can be directed towards suppressing troublesome phenomena, which, though incapable in themselves of endangering life, are harmful at any rate to the general condition. Between the treatment of symptoms and that of the causes there naturally cannot be any clear distinction; it is a question of degree.

In psychiatry, the efficiency of our curative methods is in the majority of cases far behind that found in other branches of medicine; nevertheless we do not share the pessimistic view held by some that the application of therapeutic measures in mental disease is always a hopeless task. Certainly some of the causes for our want of success are, as we shall see, inevitable; but many others will vanish with the progress of medicine.

Our methods of treating the causes of insanity are few in number. If the disorders due to syphilis, exogenous intoxications and those the result of thyroid insufficiency are eliminated, there are no other conditions in which we can commence treatment with any possibility of removing the cause. At times the cause is unknown, at times its action has been dormant for some years, or the indirect mechanism with which it still pursues its

course is unknown. We know, for example, that syphilis is the remote cause of general paralysis of the insane; but when this disease makes its appearance there is no longer any trace of the active syphilis, and antisyphilitic treatment is utterly useless. In the great majority of the acute post-infective psychoses, the mental trouble begins during the convalescent period, or even later when the external cause has been overcome, but the internal equilibrium of the vital processes is not yet regained and secondary morbid effects of a rather obscure and elusive character persist. Finally, it occasionally happens that we have not to deal with a morbid process in full activity, but only with its sequelæ. In the majority of the infantile cerebropathies the morbid process, which by damaging the brain determines the disease, develops rapidly many years before the patient comes under the observation of the alienist; and often the symptoms are of a very insidious and fleeting character, the effects of the attack remaining latent for some time. Intractable epilepsy can be developed many years after trauma or an infection, and the immediate cause which determines it is not a true inflammation but a cicatrix in the brain which may be very localised. It is hardly necessary to mention that the treatment of causes is absurd when the disease is the result of a degenerative process handed down from one generation to another, inducing constitutional anomalies.

Even when the cause is indisputable we are not always successful, on eliminating it, in restoring the organism to the normal, because the noxious agent does not produce the mental disease directly, but through extra-cerebral lesions which are not always reparable. Perhaps this is the reason why attempts at applying the theoretical principles of serumtherapy to alcoholism, pellagra, certain cases of epilepsy, and to general paralysis of the insane, have proved up to the present a complete failure. Those who look hopefully to serumtherapy for results

seem to forget that its application is still exceedingly empirical.

The treatment of symptoms in a goodly number of cases can influence the course of the disease very decidedly. In the majority of acute psychoses the morbid process is of itself curable, but the patient's life is endangered by the states of exhaustion, agitation and insomnia, by refusal of food, by scantiness of digestive juices, by perversions of gastro-intestinal functions following abstinence from food, by constipation, by want of oral cleanliness and by the infections which easily make the debilitated organism their prey. In these cases remedies directed towards counteracting the symptoms, for example, those which restore calm and sleep, heart tonics, hypodermic injections of physiological solution, intestinal lavage, artificial feeding, the administration of digestive ferments, all restrain the progressive exhaustion of the strength and allow the curative process to be developed and thoroughly established. It is hardly necessary to add that every means of protection against suicide, self-mutilation, and other perversions of the instinct of self-preservation often tide individuals through afflictions which are curable spontaneously, and thus the patient returns to the enjoyment of a perfectly normal life.

In diseases which are not directly fatal treatment directed to combating the essential symptoms— agitation, insomnia, anxiety, refusal of food—prevents the appearance of those manifestations of debility which aggravate the course of the disease and diminish the resistance to intercurrent affections. In any case, apart from the effects of symptomatic treatment, in relation to the preservation of the patient's life and the cure of the disease, the necessity for such a treatment in incurable diseases is obvious; here our aim is to reduce their severity, render them less ungovernable, less injurious, and less distressing. In certain maladies the prognosis is certainly ominous from the first, but as in

practice we meet with constant surprises, it is necessary meanwhile to employ all methods of treatment.

To preserve a crowd of idiots and dements, to reserve special treatment for their benefit in order to maintain them under good hygienic conditions and protect them from disease, may seem to any one a useless mission, one even socially injurious. It may even be said that such methods are inspired by a misguided spirit of philanthropy or by a kind of sublime respect for human life and not by the explicitly defined standards of social utility. This is a gross error. It is the duty of a civil society to protect these rubbish heaps of human personalities not so much for the advantage thus conveyed to organisms of dim and even degraded consciousness but for another and a useful reason, that of maintaining on a high plane the bonds of social unity of interests against misfortune, and of respecting every feeling of sympathy which, if only computed in pounds shillings and pence, may appear to some as sheer extravagance, but which constitutes nevertheless an integral part of that treasure of altruistic feelings without which no society could continue and progress. A civil society which respects the incurable patient, though useless and costly, respects itself, and willingly takes upon itself that moral inheritance which is the result of generations of sufferings and hardships and cannot be expressed in arithmetical terms. The Spartan laws, merciless to the weak, if they can still form the ideal of some parsimonious and uncultured administrators, are repellant not only to those who are looking into the future but also to the temperate opinion of present society.

Another most important aspect of the treatment of the insane is their preservation from danger, and the protection of society against them. The insane are persons who are unfit for normal surroundings where they are exposed to constant danger, and are sources of danger to the sane who surround them. Hence the

necessity for creating a suitable environment for them. Society, to be honest, has made its own danger the primary consideration, and this was the sole motive which led to the isolation of cases of mental aberration. The idea of creating for the insane an environment in which not only every source of danger but every stimulus likely to lead to abnormal activity in the diseased mind would be excluded, only occurred later. What has been done in this direction is anything but complete. And yet in treatment it is of supreme importance that the diseased organ should functionate as little as possible. Even if the morbid process is incurable it is useful to restrain the diseased organ from disorderly activity. And when only limited and crippled psychic functions are preserved owing to the havoc wrought by the disease, it is well to facilitate the reorganization of the surviving activities in such a way as to render the condition and the conduct of the patient as little dissimilar as possible from those of normal persons.

This environment adapted for the treatment and custody of the mentally afflicted, this environment of quietude, of isolation, which grants a truce if not peace, which minimises or abolishes all irritating stimuli, which relieves the patient of the turmoil incidental to life, is the asylum.

It may appear paradoxical to say that the asylum provides a quiet environment. It is certain that the conception of asylums generally held is very much the reverse, a conception which lives on memories of an all too recent and vivid past; memories of nameless horrors, of indescribable sufferings. And there is no doubt that the mistrust with which a very considerable portion of the public still regards these institutions is not everywhere unjustified. The humanitarian work of psychiatry is by no means finished; in very few places is the organization of asylums what it should be.

Organization ought to be guided by the data of experience and directed by a generous humanitarian sentiment. On this point the differences between one country and another are very great. There are places in which the reform instituted by Chiarugi and Pinel is far from fulfilment or has never been commenced. In many Spanish asylums, governed by monks, chains are always in use; at Cagliari they still existed in 1893, and at Venice in 1901. In other places if chains are not used there are thousands of substitutes, and the mode of life is not superior to that of the worst prisons.

There are enormous differences in the asylums of various countries and between the asylums of the same country. Sometimes asylums are merely adaptations of ancient buildings, modified to the best possible advantage. Monasteries have been put to such a purpose, and naturally form huge gloomy edifices with narrow closely barred windows, from which hoarse grunting bestial noises pour out on the country side; inside there are dark winding passages, immense squalid and bare dormitories which are cold and badly ventilated, and here during the night the most offensive odours catch the breath and turn the stomach. Or the asylums may be built like barracks and be in a state of disrepair, full of cells, of heavy doors, and noisy bolts; whole pavilions are set apart for restless patients, or worse still for dirty cases; there are court yards in which seventy or eighty cases are huddled together, constantly restless and howling incessantly. Such places seem expressly built with a view to multiplying stimuli and pushing agitation to the uttermost limit. Then there are colossal institutions no doubt more comfortable, better arranged, and sufficiently clean, but in which one feels in everything, in the clothes and food, in the beds and furniture, the levelling conformity of design of a great administration which aims at economy with uniformity,

and therefore loses sight of the individual in only recognising the crowd. Think of the difference in certain institutions of more civilized countries, where the patients in small groups, quiet, cared for, and clean, are maintained in seemly and well-kept surroundings, with the windows adorned with flowers and the walls with pictures; or where they occupy their time with easy and graduated work in the fields under the intelligent supervision and observation of educated and expert attendants. In these institutions the dirty class is reduced to a minimum and violent restlessness is much rarer than elsewhere.

Asylum administration corresponds in great measure with the economic conditions, the habitual tenor of life, and with the degree of civilisation of each nation. But not entirely so. Unfortunately it is still too true that the interest of the public in asylum conditions is very slight. The conviction that all mental diseases are incurable, that the insane are social refuse, a load for public beneficence and nothing more, is far too firmly rooted. This is the reason for the prevalent tendency to curb the development of asylums with principles of absurd economy. And where the apathy and scepticism of the doctors echo public indifference, want of enterprise and stagnation can lower asylum life below the average of the country. Therefore it is necessary that attention should not be diverted from asylums; that these should not be considered as inaccessible places; that relations of patients should be made acquainted with all that happens; these are the best methods of combating the prejudice against insanity and asylums. Above all, it is necessary that the directors of our institutions should not maintain a passive and accommodating attitude towards the stinginess and incompetence of administrators, but ask in no uncertain voice for what is required, without weakness and without philanthropic or professional brag, if the wish is still entertained that

our asylums should not become a disgrace to the country. Certain it is that such a programme is not always easily carried through, but this endeavour which is essential for the improvement of our asylums will at the same time lead to the medical officers occupying a higher moral position.

Let us indicate the most urgent reforms at which we should aim. First of all, the insane must be taken out of the hands of private and public speculators. If it were proposed to commit the ordinary hospitals to the care of a syndicate, the suggestion would be met with a chorus of vehement protest; public opinion would be indignant at such an outrage of the most elementary feelings of humanity. But we find no such protest against the committal of the unfortunate insane to private speculators. In the case of the general hospital the sick enter and leave voluntarily, preserve their full consciousness and are in a position to protest against any attempt at ill-treatment, and have besides relatives who are interested in them and can protest for them; for the madman there is little or none of this.

In Spain the monks and nuns have the sole rights of exploiting the insane; in Belgium the monks govern and administrate the male asylums; in Italy there still are asylums owned by lay but private managers, to which the Provinces send their insane. In institutions of this type everything is permissible, the supervision by the public counts for nothing, and that of the officials is a mere farce.

The motive of private enterprise cannot be that of philanthropy; it must be, and is, gain. Now, if with good organisation it is possible to economise on the sum paid by the public Administration for every patient, it is the duty of this body to make that profit itself and put it to the public funds. And if the profit of private enterprise is the result of illicit economies, which are injurious to the patient and to the ends for which an

institution is intended, then the Administration shows criminal complicity.

Certain it is that the condition of the insane is no better when they fall into the clutches of certain charitable institutions, which, through defect or crowding of public asylums, exploit for their own benefit the industry of the insane with the sole intention of increasing their own revenue. The greed of certain administrative bodies, thanks to the passive attitude of certain medical gentlemen, has reached incredible limits. In one of these so-called asylums the mortality once reached a figure higher than that of the fiercest epidemics, and the Provinces which had sent their patients there were compelled to recall the few survivors hurriedly in order to save them from certain death.

Such shameful indecencies are certainly tending to disappear. In many asylums important developments have taken place and several others are arising from them. When every Province possesses one or more asylums industrial speculation will cease, and also the removal of patients to institutions hundreds of miles distant, under conditions more fit for cattle than human beings. But it would be well worth while to hasten this reform in order to wipe out as soon as possible such a disgraceful blot.

Apart altogether from private speculation, there is much to be desired in the department of public administration. It happens too often that administrative and political intrigue sends most unsuitable persons to govern asylums, men wanting in all technical and administrative experience, who have no other aim than economy, even though it be attained at the price of the decadence of the institution committed to their charge. It is very difficult to make such persons understand that a radical reform in the treatment of the insane, though it involves considerable expenditure of capital for improvements, can lead to economy in certain

directions, and to a state of affairs more in keeping with civilisation. That a disease well treated from the commencement may result in the discharge of a patient and so spare the asylum a chronic case; that the damage produced by dirty and destructive cases may mean the maintenance of a larger nursing staff and the free use of baths; that employment can be a source of gain and at the same time tend to promote the welfare of the patient and the discipline of the asylum, is incomprehensible to many administrators. Limited by a sense of mistrust, always disposed to regard the doctor as an expansive enthusiast or one whose humanitarian sentimentalism has filled him with Utopian dreams, they cannot be induced to adopt any reform unless public opinion compels them after the clamour caused by some particularly offensive scandal.

Another point which must be peremptorily insisted upon is that of placing asylum management under the complete control of the laity. Unfortunately the idea that the clergy are specially qualified for the management of charitable and humanitarian affairs, such as looking after the sick, is firmly rooted; and many who do not come directly into touch with such matters are firmly of opinion that religious bodies have a prior claim in hospital nursing. Experience shows, however, that an educated, trained, and responsible lay person is always preferable to one who has not been trained and who seeks to evade responsibilities and discipline.

In all that concerns the nursing of the insane there is therefore a specific contra-indication. The last disease on which a priest can form an intelligent opinion is insanity. The priest's view of insanity, on account of his training, must be diametrically opposed to that held by scientific men, and his dogmatism must be in direct proportion to his sincerity and logical reasoning. The fatal determinism of the disease, the absence of error or of sin on the part of the patient and his irresponsibility

are conceptions which cannot be assimilated by the mind of the priesthood. The consequences of this are obvious. The tortures, the persecutions which were endured for centuries by the insane have always been dictated by religious ideas. The greatest difficulties placed in the way of those who recognised insanity as a disease and advocated the institution of asylums as places of treatment, came from religion. The worst asylums in existence to-day, those of Belgium and Spain, are governed by priests. In the asylum at Cienpozuelos near Madrid, administrated by monks and nuns, there is only one doctor, and he is not an alienist; he must limit his attention to the treatment of pneumonia, enteritis, and any other intercurrent disease, while the priests provide for the treatment of mental aberration by using every means of coercion known to man.

In Italy there still exist certain conspicuous instances of the manner in which religious bodies nurse the insane. In the male divisions at the present time all the nursing is done by laymen. The last monks were recently banished from the asylum of San Servolo in Venice, and with them the chains and fetters; but in the female divisions, with few exceptions, the duty of supervising the nurses is entrusted to nuns, who also direct the general working. There is an asylum in which all the duties, even the humblest, are discharged by nuns; and a regulation had to be passed prohibiting the use of the straight waistcoat as punishment for blasphemy and abuse. Here we have a most expressive index of the mental attitude of religious persons towards the insane. But such persons are obviously unfit even for general supervision. The tendency to torment the sick by suggestions of religious ceremonies or with noisy sermons, the partisanship shown in the supervision of subordinates according to their zeal in religious duties, the petty and continued persecution, the favouritism, the inquisitorial investigations into the habits of the nurses,

the incitement to inobservance of the regulations, the officious interference with technical matters, the spiteful spirit of faction and conspiracy, are the uncontrollable tendencies of nuns, and give rise to continual intrigue, jealousies, and disputes in the divisions to which they are appointed. It is necesessary to take measures for the eradication of these last traces of bygone times, and to remove the germs which under favourable conditions always show a strong tendency to bud afresh.

Asylum reform must aim at making some differentiation amongst the institutions provided for the retreat of the insane. Up till now asylums have invariably been rather imposing buildings situated outside the city and often at a great distance from it. In these are collected not only all the insane of an entire province but even of several provinces. It naturally follows that the process of admission into an asylum, even apart from the wearisome slowness of legal formality, is exceedingly difficult and troublesome. Those who suffer most from this system are precisely the acute cases of a curable type, constrained as they are to remain in their houses or in the small provincial hospitals, where their malady is not understood and cannot be treated, or to undertake journeys most prejudicial in themselves and even risky to life. It is not rare to see a patient in a low state of physical health arrive at the asylum exhausted and worn out by a long carriage journey passed in constant agitation and suffering, and controlled by a number of improper and badly applied means of restraint. Sometimes these patients collapse and die a few hours after admission.

It is urgent therefore that in all the more populous centres small hospitals should be instituted for the admission of new cases and for the treatment of acute forms. These institutions placed in closer contact with the public, easily accessible to the patient's friends and relatives, would be of enormous benefit in preventing

numerous deaths and reducing the tendency to chronicity, and would be of value also in dissipating, by their resemblance to ordinary hospitals, the mistrust and hostile attitude of the public towards asylums, a mistrust and hostility which, as we have seen, are not entirely unjustified. Only after a sufficiently long period of observation, and on the recognition of a distinct tendency to chronicity should the patients be sent to true asylums, where naturally—granted the patients were selected with care and intelligence—the organisation would be principally directed towards the treatment of the chronic forms, and to the regulation of habits by means of work.

Experience teaches us that it is advantageous to provide special institutions for certain classes of patients, especially for idiots, for cases of late and imperfect psychic development, and for epileptics, provided these are mentally sound and in good health. The institution of asylums for criminals, a suggestion which is recommendable on theoretical grounds, to be candid has not been at all successful in practice, chiefly on account of the defects in the principles of application. In consigning patients to the so-called judicial asylums the legal criteria have completely pushed the clinical knowledge into the background and this has led to injurious promiscuity by associating dangerous individuals with others who either were originally harmless or might have become so in time, or been rendered so by disease. As a working scheme the judicial asylums have up till now simply increased the defects of asylums and prisons. Until recently it seemed necessary to place these judicial asylums under a double directorship consisting of a doctor and a prison officer! And the remedy adopted in the recent Italian statutes for asylums, that is to say, the institution in every asylum of "isolated buildings for dangerous patients permanently detained and for those under judicial observation" only maintains the deplorable promiscuity and lowers

the level of the ordinary asylums almost to that of the judicial ones by introducing customs and standards more adapted for prisons than hospitals.

Amongst institutions for the insane, psychiatric clinics deserve special attention. It is evident that for the necessity of teaching, these institutions must bring together patients of every kind; on the other hand, however, they must not be of such a size as to permit of unlimited time of residence for numerous chronic cases. The best solution, and one easily obtainable in large cities, is to grant to this clinic the function of distribution, so that new patients could be placed under observation and the acute varieties of insanity treated. At the same time the clinic should be placed in the immediate neighbourhood of a large asylum, from which cases even of long standing could be readmitted if only for a short period of time. The investigations of the laboratory, the post-mortem examinations, microscopical studies, and experimental researches—facilities for which, however, ought to be provided in every asylum—would find in the clinic their proper environment and the means for their more extensive and practical application. In this way clinics can be of service not only to the pressing necessities of teaching and science, but also in helping the intellectual and moral elevation of the students who there receive instruction with the view to becoming medical officers in asylums.

The difficulties met with in attempting to treat mental diseases, difficulties which especially depend on the complexity of the pathogenetic process and still more on the impossibility of directly combating in the individual the morbid causes which may have arisen in past generations, necessarily force us to seek for success in *prophylaxis*. This holds out so much hope in other fields as to justify our calling it the true medicine of the future. As in all questions connected with prophylaxis in

general, direct practical action on the part of the medical man is very limited, prophylaxis being more a social task than one for individual effort; but the indications for the lines prophylaxis must take, can only be the outcome of scientific researches in etiology and pathogenesis; and besides, it is the doctor's business to diffuse knowledge and new ideas amongst the public and form the necessary propaganda so that every citizen may demand from the public authorities those legislative measures which science may suggest. How great is the importance of prophylaxis in regard to mental diseases will be sufficiently proved by a rapid sketch of the more important forms considered from the point of view of their etiology.

There are mental diseases which would shortly disappear could the interest of society be sufficiently directed towards them and timely measures adopted. We are not entirely acquainted with the etiological mechanism of pellagra, but we do know that the consumption of damaged maize is the means by which the poison of this disease enters the system. Legislative measures directed towards preventing the consumption of damaged maize, and the co-operation of public charity in replacing it with a diet more fit for human beings have attained a certain measure of good where the evil was more rife and firmly rooted. In northern Italy pellagra is diminishing, but unfortunately it must be admitted that it is spreading to other parts, where the danger is less recognised and where preventive measures are less well organised. Generally speaking, the campaign against pellagra is too lacking in vigour, and charity is defective and slow. The lot of the labourer is still abandoned to the blindest individualism, and among the ruling classes the conviction has not yet penetrated that the decadence of the physical strength of the worker, the diminution of the capacity for work, the premature deaths, the degeneration of the race, the

chronic diseases which require long periods of treatment in hospitals and asylums, cost the general economy of the country more than the expense which would be incurred in stamping out the evil.

The same arguments may be repeated with regard to cretinism. We are not yet acquainted with the cause of this disease; but, on the other hand, we know sufficient of the pathogenetic mechanism. This depends on a lesion of the thyroid gland. We know that the cause of the disease is connected in some way with locality, and that is why cretinism is endemic in some places and quite unknown in others. We have reason to suppose that if some of the local conditions which favour the development of this disease are irremovable, such as altitudes and oro-hydrographical conditions, others must be removable. Indeed it is demonstrated that in certain places, in which cretinism formerly raged, the improvement of general hygienic conditions, the use of water different from that formerly used, the opening of new paths of communication, and the consequent economic awakening of the country have caused the number of cretins to diminish enormously. But at the present day we combat cretinism with an heroic and specific remedy—the thyroid treatment. By the daily administration of very small doses of dried thyroid to young cretins, remarkable modifications of somatic and psychic development are obtained, which are the more striking the earlier the treatment is commenced. Now it is evident that if in the countries in which cretinism is prevalent such a remedy were employed at the first appearance of the symptoms of the disease in infancy, or better still given in a more attenuated form as a preventive measure, the development of the morbid symptoms might be warded off entirely. The whole population could be regenerated in twenty years by spreading with a minimum of expense the use of this therapeutic measure, by taking advantage of the services of the municipal doctors, of the health

officers, and of the provincial doctors; because, it is noteworthy that in these places where cretinism is rife all the inhabitants suffer in a more or less accentuated manner from the disease, and those who are not cretins or semi-cretins show at least the stigmata of the so-called cretin constitution, which may be psychic as well as somatic. The characteristic symptoms of the disease are torpor, inertia, muscular weakness, and consequently incapacity or limited capacity for work, and a reduction of the average standard of life. The state which has recently displayed a laudable initiative in the fight against malaria by spreading the use of quinine, could take upon itself the much lighter and proportionately not less useful task of spreading the use of the thyroid treatment and prophylaxis of cretinism.

Everyone knows how alcoholism may be a grave social scourge, how it may degrade the worker and undermine his health, his capacity for work, his aspirations of rising in the social scale, and how it may be the direct or indirect inspiration of innumerable crimes. Alcoholism contributes enormously to the population of asylums, into which individuals ruined by alcohol come by a variety of ways. On the one hand, we have the true forms of alcoholism, the acquired alcoholism of adults in all its diverse forms: delirium tremens, chronic delusions, epilepsy, and dementia. On the other hand, there are the products of degeneration. Alcoholism in the parents may not only be the direct cause of deviations in development and therefore of congenital mental disease, but it also diminishes the resistance of the infantile brain to diseases from external causes. These are very common in infancy and stamp indelible traces on the weakened brain, giving rise to forms of idiocy, imbecility, and epilepsy.

Without doubt the uncomfortable conditions under which the worker carries on his occupation contribute in the greatest measure towards provoking alcoholism,

for the reason that his capacity for work is subjected to severe sweating and as a result he uses the poison which smothers the sense of fatigue and gives a transient feeling of well-being, a gleam of happiness, which temporarily chases away the hateful spectre of sad and oppressive reality. Surely we ought to expect much from the progress of social justice and from the consequent progressive improvement of the economic conditions of workers. But the line of preventive action must not be too narrow or biassed. There is no doubt that legislative measures and above all energetic educative propaganda can restrain the evil and reduce its proportions. Norway, which at one time was one of the most drunken of countries, gradually became, through education and legislation one of the most temperate.

It must not be supposed that the anti-alcohol campaign ought to concentrate its efforts, as sometimes happens, on the didactic demonstration of the evils of alcoholic intoxication, or on holding congresses and preaching moral sermons. Indirect methods are the most useful of all. Every endeavour which aims at raising the labourer morally and intellectually and creating an ideal, helps the purpose in view; and the participation of the proletariat in political and economic questions is of more value than any other method. But the most indirect method, and one which should precede all other methods, is education. The want of education renders men impenetrable to every form of propaganda, hinders the expansion of their intelligence, deprives them of the faculty of seeing any possibility of social improvement, and keeps them in ignorance of their own potential power. Every effort which aims at improving the education of the people is at the same time a weapon against alcoholism.

General paralysis of the insane is one of the most deadly diseases. It attacks adults in the full vigour of life, individuals strong in body and mind who as a rule

have reached the highest point of their social activity; and it ruins them irretrievably. The remote cause of progressive paralysis is syphilis, and all prophylaxis in regard to progressive paralysis must be directed against this disease. Syphilis is also the cause of a large number of infantile cerebropathies, and of cerebral affections in the adult; and although the latter are amenable to curative treatment, it is very rarely that they leave the cerebrum entirely sound.

The prophylaxis against syphilis is at present one of the tasks which have been undertaken by the public, but, unfortunately its efficacy has remained very limited. Prostitution, with which syphilis is closely associated, is a social defect whose remedy we do not yet grasp. Some change in the social condition of woman and as a result a radical reform in family life, may possibly check this evil. We derive much hope too from the recent discovery of the specific micro-organism of syphilis. At any rate, limited as we are in treatment at the present day it is necessary to press home the attack against syphilis, and one of our duties is to fight the prejudice which unfortunately some medical practitioners hold against mercurial treatment. It is now completely demonstrated by clinical experience that mercury is the only specific against syphilis, and that it is the more efficacious the earlier the treatment is commenced and the more thoroughly it is carried out. These principles aim at preventing the appearance of secondary manifestations and form at the same time the best prophylactic measure against the spread of the disease.

The infantile cerebropathies, as we have seen, are to a considerable extent the result of parental alcoholism and syphilis. But perhaps these are not the most frequent causes. The infections which arise in the first years of life, and especially the inflammations of the gastro-intestinal tract—the result of unsuitable alimentation during the lactational period—are the most important

factors in determining the majority of cerebropathies, and in this way a crowd of idiots, imbeciles, and epileptics is produced, who encumber asylums and are an enormous drain on the internal economy of the country, as also on public charity. All measures directed towards favouring natural maternal feeding, and providing the poor with the means for carrying out artificial feeding —according to the most rational methods—form the best means of prophylaxis against the infantile cerebropathies. In the most civilised nations, especially in France, the movement in favour of the use of prophylactic means is very strong and steadily growing. In fact a notable reduction in the infantile mortality has been effected, and along with this a diminution in the number of the deformed, and of children physically and mentally weak from earliest infancy.

The acute confusional psychoses—apart from any hypothetical predisposition—depend on external causes, viz., infections, states of impoverished health, overwork, and intoxications. That such is the case is sufficiently proved by the fact that these diseases rage principally amongst the working classes, who, having to toil under unfavourable hygienic surroundings, are more than any other social class exposed to all causes of the disease. Here the prophylactic measures should be directed towards improving the regulations and the hygienic conditions under which work is done, and towards obtaining legislative measures in order to protect the life and health of the worker.

In women two important causes of insanity, especially of the acute variety, are the puerperal and lactational periods. It is evident, therefore, that everything promoting health during gestation and the puerperium, all the means which favour rational artificial feeding, and all the principles which aim at placing even working women under hygienic conditions during their term of

maternity, will constitute prophylactic measures against insanity.

Generally speaking, it may be said that all improvements in public health, in hospitals and in houses, in streets and in schools, in barracks and in factories, in cities and in the country, everything which elevates the tone of life, every principle which tends to regulate social relationships and render them less harsh, all progress in education, all increase of wealth, morality, and intellectual taste, in short all progress in civilization is a means of preventing insanity. All this shows us how unfounded is the pessimistic prejudice of those who, mistaking an increase of the numbers of persons under asylum treatment for a real increase in insanity, make statements calculated to alarm the public, and accuse civilisation of exacting from the human brain an excessive amount of activity. The human brain if sound is capable of higher and more concentrated activity than that displayed by the average person of the present day. It is only morbid causes of external origin which attack it insidiously and are able to injure it and weaken its vigour by intoxications. Now these extraneous causes are not due to civilisation but to defects in the social structure and deficiency of production. Far from favouring these social defects, advances in civilisation constantly tend to overcome them.

Those who are sceptical that a successful fight can be waged against the external causes of insanity by prophylaxis, only find support for their argument in the weak and ineffectual action which can be directed against the internal factors of insanity, by which we mean the anomalies and predispositions. And in truth how very ludicrous our prophylactic measures would be if they had to be limited to those suggested by the theories of universal degeneration.

The spectre of heredity suggests the prevention of marriage amongst those predisposed. It is possible to

give the best advice on the question, but it is never carried out. That individuals who are insane or who have been insane at some time or other are not the most suitable persons for marriage is already recognised by all; but admonition in this connection usually has little or no effect. On the other hand it would only be captious to deter from marriage one psychically sound simply because his family tree contained several cases of insanity. To predict a bad outcome of marriage in such a case would be to adopt the easy confidence of the charlatan, and the party interested would never allow himself to be convinced.

The recommendation to apply Malthusian principles to degenerates is founded on analogous arguments. It is as if one recommended abstinence to inveterate drunkards, and prudence to insane persons. Laws prohibiting degenerates from marriage and suggesting their castration have been proposed. In America such a law was actually proposed and approved of for habitual criminals, but never placed in force. To-day some support a milder but not less efficacious means—resection of the vas deferens. At the present time there are some who propose to sterilise degenerates by means of the Röntgen rays.

In this question the usual mistake is shown regarding the importance of degeneration, and the transmission of heredity. There are some who consider as hereditary all transmission of normal and abnormal biological characters, even though accidental; but in doing so the same undeviating rigidity of mechanism which is peculiar to physiological heredity is granted to the transmission of morbid characters. Degeneracy itself and the segregation of the insane constitute a most powerful check on reproduction, and if the effects of this check are not felt throughout generations, we must surmise that the premise of heredity as the prevailing factor is wrong. Prophylaxis against degeneracy

consisting in the prevention of reproduction, should be carried out on those who may be called degenerators rather than on degenerate organisms. But if it is almost superfluous to preclude the idiot from marriage and reproduction, on the other hand, it would be impossible to prevent the union of all the individuals who are in a condition to procreate degenerates, all alcoholics, all pellagrous, all women not under circumstances to complete the lactational period, all workmen exposed to intoxications in the exercise of their trade, all syphilitics, in fact four-fifths of humanity. All this effort would be insufficient in any case because every organism, however sound it may be, can become capable of producing degenerates when exposed to morbid causes.

The range of morbid heredity is, as we saw, more restricted than has generally been admitted. In any case the mechanism of morbid heredity does not resemble that of normal biological heredity. If it was identical with it the constant selection attained by the segregation of the insane in asylums would suffice to restore humanity. But the primary disturbance is acquired, and is reflected in the same or some other form in several generations; degeneration is therefore a disease of the stock which is acquired through external influences. It is against these external causes that we must direct our activity.

One of the most important practical problems connected with the subject of psychiatry is that of the relation between mental diseases and *crime,* between psychiatry and *punishment.*

No conception of crime which is not deterministic can be recognised as scientific. Determinism is a universal law without which experience would be valueless and prevision impossible. This law is applicable to psychic as to other phenomena; and if normal psychic phenomena are subject to this law, there is no reason why pathological or any sort of abnormal phenomena should be

excluded from it. We have seen that the determinism of psychic phenomena can be investigated objectively in the organic structures, in physiological and pathological dynamic activities, in the effects exercised on the organism by external stimuli. The study of the subjective phenomena if it does not admit of quantitative valuations comparable to those of the physical world, reveals some approximate laws which enable us to foresee events with some degree of probability if not with certainty. This in itself is sufficient to demonstrate that there is a determinism because without it even the approximate foretelling of events would be impossible.

A naturalistic study of crime, which seeks to discover its causes and its mechanism in the organism of the delinquent and in the conditions of the environment under which crime occurs, is therefore fully justified. Without doubt we owe a great deal to those clinicians and anthropologists who have attempted to define the psychological and somatic characteristics of criminals in those cases in which the crime seems to depend on the internal constitution of the delinquent rather than on accidental external causes.

This research which has been going on for many years and has achieved its most definite results, from the point of view of psychiatry, in the clinical study of moral insanity owes much of its success to the anthropological school directed by Lombroso.

But if the results of these researches have been of some value in demonstrating a certain affinity between insanity and crime, they have in some respects led us astray from strictly scientific methods, and have narrowed our view of the whole subject. We have several times pointed out how erroneous it is to regard the criminal as an anthropological variety, and we have drawn attention to the mistakes which would arise from such a conception in the interpretation of the somatic signs on which criminal anthropology has based a special symptomatology.

The dissemination of the discoveries of criminal anthropology, the hasty and often simplicist explanations of the phenomena observed, and the persistence with which the disciples of the new science have carried their dogmatic ideas even into the law courts, have convinced the general public that criminal anthropology has accomplished a two-fold revolution, first in the general theories of penal law, and secondly, in its practical applications, that is in making the punishment proportionate to the crime. In this, however, we recognise a double error, based on various illusions.

The first illusion is that criminal anthropology has delivered a heavy blow against the doctrine of free will on which the old penal systems were based. As a matter of fact science had no need to wait so long before giving judgment on the doctrine of free will. The existence of psychological and physiological science involves in itself a denial of such a doctrine. Even if criminal anthropology should furnish us with a complete biological personal description of the delinquent, the minute mechanism of psychological determinism which leads to the crime would still remain hidden. To say that the criminal has a special organic constitution is to reaffirm in detail, although without much direct evidence, the existence of a generic relationship between the somatic structure (especially of the brain) and psychic functions. Criminal anthropology adds nothing of much importance to the knowledge which has already been attained through the study of anatomy, physiology and comparative psychology. It is not necessary to enter into too minute detail to be able to recognise this generic relationship; it is sufficient to demonstrate that a man, a dog, an ox, a rat, a frog and a bee possess different psychological characters, specific ways of conducting themselves in life according to their environment, and that no one of them could possibly assume the mode of thought, of feeling and of acting of another.

Theoretically the old systems of penal punishment are based on the idea of free will, and, according to them, the punishment is looked on as an expiation of a crime which has been committed voluntarily. The whole system of punishments is nothing but the practical outcome of these theoretical principles. But such an interpretation is both superficial and erroneous. Rarely can human actions be considered to be the strictly logical result of a theory; this is especially true in the case of collective actions such as the elaboration of a penal code. Penal law, like every other social phenomenon, is evolved according to the momentary exigencies of society; the evolution of an explanatory theory always comes later and is dependent on the necessity for providing a satisfactory reason and a philosophic basis for that which was decided by the contingencies of the moment.

Judged from this point of view the value of penal standards alters considerably, and putting aside the mystic veil of metaphysico-religious theories, we find that the whole framework of practical codes is inspired by a sound common sense which often only partially agrees with the theories and may indeed be utterly opposed to them.

Something analogous to this is seen also in the realm of individual opinions and actions. There are many professed believers in the doctrine of free will, but not one of those who support this principle can avoid making use of the purest determinism in practice. On what do we base our judgment of other personalities if not on the firm conviction of the importance of determinism? Moreover, do we not attempt to foretell the actions of other people with the help of determinism? And what significance could be attached otherwise to our constant endeavours, at all times and in all contingencies to influence the actions of others by advice, by orders, by

requests, by veiled suggestions, by flattery, by violence, by persuasion, and by subterfuge?

The same contradiction is apparent in the field of penal law. In spite of the assertions of those who accept the principle of free will, it is always admitted that the punishment may have an intimidating influence and thus be preventive of crime, that it may be a *determinant* of human actions. The importance of external circumstances is always taken into account when we judge of the gravity of a crime, so that the determining value of great provocation or of the necessity of defending oneself against a violent attack has always been recognised. The moral judgment on the motives for the crime, which varies with the standards of the period, has always been taken into consideration by the public conscience and by the laws. Now all these examples indicate an acceptance of the doctrine of determinism, which may be unconscious, but is not therefore less effective.

But there is considerable reason for saying that the penal systems now in force are to a large extent a survival of the sentiment of the vendetta. The manner in which our penal systems have been evolved from the original vendetta is psychologically of great historical interest, and brings out still more strongly the fact that penal systems have practically nothing to do with the doctrine of free will.

The instinctive feeling of vendetta is not only prehistoric, it is prehuman; it really takes us back to the time when there was no philosophy of liberty or of determinism. It arose as an adaptation which profiting by certain psychological laws was unconsciously deterministic. The vendetta is a primitive method of defence and prevention; it gets rid of or intimidates the enemy and tends to prevent the repetition of the attack. In individual quarrels the feeling of vendetta must be controlled by that of prud-

ence, by the fear of meeting too strong an adversary; and all offensive and defensive actions will oscillate between these two affective extremes. This mode of defence with all its risks is certainly an imperfect adaptation; in satisfying the vendetta the individual might run the risk of being beaten or killed. But defects of this kind are met with in all instinctive sentiments, which are useful to the general community but may be dangerous to the individual. Their utility for the species has been sufficient to fix them hereditarily in spite of the dangers they offer to the individual.

With the formation of social communities the sentiment of vendetta began to assume the form of penal laws which are much more beneficial than individual vendetta because they avoid the uncertainties attached to a fight between isolated individuals. It is the community which carries out the vendetta, and it is very difficult for the single criminal to escape. This decreased liability to error on the part of the social vendetta allows of a greater leniency towards the individual. The individual vendetta is always excessive; it must aim at the destruction of the enemy if it wishes to provide with absolute certainty against repetition of the crime; but social vendetta can be more measured, and therefore adjusts itself better to the act which provokes it. Punishment by retaliation appeared to be an ideal of equity and justice for a long time, and every advance in penal legislation consists in nothing more than the elimination of what is excessive and hence of what is superfluous; the ideal even of the adherents of the positive penal school is simply to reduce the punishment of a prisoner to the minimum which is necessary to hinder him from embarking on fresh crimes.

The contrast between the classical and the naturalistic penal theories depends on the language used by the two schools rather than on the principles themselves. The terminology employed by the legal minds of the old

stamp contrasts strongly with that of scientific psychology. And even to-day the meaning of the questions put by the magistrate to the expert alienist is always ambiguous because of the rigidity of form, although the law attempts to reconcile the old views with the modern demands of public conscience and with the advances of clinical psychiatry. But it cannot be said that they are scientifically foolish or that a precise scientific concept cannot be found to correspond with every shade of meaning of penal concepts.

If a judge asks an expert whether a prisoner was in full possession of freedom of will and action when he committed a crime it would be rash to say that the question is scientifically foolish, as though in his conception of moral liberty he denied the influence of determinism both in the sane and the mentally unsound. Quite a different, but still a perfectly precise meaning is contained in such a question, one which gives an obviously naturalistic signification to the idea of moral liberty. In the majority of instances a free action is understood to be one which is executed by a personality under normal conditions and without any compulsion from outside, while an action not free is one which is carried out under the influence of some disturbance of the personality, something added, extraneous, abnormal. Such a question, therefore, is an attempt to define the limit between insanity, using this word in its strict sense, and the normal or the constitutional anomaly. We admit that in an insane patient an internal change has occurred which has favoured or determined the criminal act, while in a patient who is the subject of an anomaly by constitution there is no internal change and the crime is in his case an example of the way in which he habitually reacts just as are the actions of normal individuals. From the naturalistic point of view it must be admitted that the distinction is anything but foolish.

So also when the question of the consciousness of an action is raised it would be futile to object that all actions are determined, be they conscious or not. But the term consciousness admits of two interpretations. Consciousness may be considered in a very wide sense as a subjective state, and then those acts must be described as unconscious which are carried out without preconception and without any knowledge of their taking place, or consciousness may be understood in a much more strict sense, as the knowledge of the judicial and ethical value of the act itself, and then those acts will be described as unconscious whose execution is recognised in consciousness, but whose value as acts contrary to morals and laws is not appreciated. In this case also it is undeniable that the distinction is far from being worthless from the naturalistic point of view, and that there is a great difference, both from the side of the deterministic interpretation and of the consequences in relation to social defence, between a homicide committed by a man in a post-epileptic condition or in a state of profound inebriety, the rape committed by an imbecile and the swindle worked out by an astute rogue.

In conclusion, and avoiding technical terms, what is required is a practical distinction between the insane and anomalous and normal individuals. Such a distinction is easy in many cases, but in others it is extremely difficult or even impossible without making use of arbitrary standards. We have already seen that there are intermediate links between insanity and the anomalies; but the greatest difficulties are met with in those cases which lie near the borderland of the normal. Criminal anthropologists have already been obliged to introduce an intermediate class, which includes those who commit crime under some strong emotion, between the born or organic delinquent and the occasional criminal who is driven to crime by external circumstances. This intermediate class is a transitional form

because the emotional states are produced by purely psychogenetic influences of the external world, by incidents which arouse the emotions and they then lie very near the normal; or they are determined by accidental and transitory organic states and then they approach insanity; or they consist in slight abnormalities of character, in particular tendencies, in an excessive impulsiveness, and in that case they are closely allied to the anomalies. Further, the occasional delinquents may be subdivided. There are individuals who never under any circumstances allow themselves to commit an offence or at least certain offences; individuals whose ethical sense has become so acute and so inflexible as to have conquered even the feelings connected with the fundamental instincts of life. This may very well be considered a weakness, an imperfection rather than a virtue, but at any rate these individuals, from the naturalistic outlook, are very different from those others who fall into transgression under a very small temptation. Speaking generally there is always an internal factor, strong or weak, concerned in crime, excepting perhaps in certain forms of collective crimes in which the imperious law of psychic contagion prevails and all sense of responsibility is obliterated.

At the present time the diagnosis of insanity is made within the limits of the positive criteria which we possess and which are the fruit of clinical experience. The diagnosis of the anomalies is a matter of greater uncertainty and still lacks any trustworthy scientific basis, and it has been a mere exaggeration on the part of criminal anthropologists to boast that they have discovered a new and reliable diagnostic technique. The somatic signs, on which the attention of the investigators has been principally fixed, are open to criticism because anthropologists regard them as evidences of atavism. We have already insisted on the close connection between atavism and pathology, on the pathological value of these

signs and on the want of the necessary correlations between these particular conditions localised outside the brain and the cerebral functions. The connection between these somatic anomalies and crime is assumed from a study of statistical tables, which are themselves open to criticism, and from which no certain deductions can be drawn as to the relationship between cause and effect. The clinical alienist can foretell what the conduct of a lunatic will be to a certain extent, and can also diagnose with fair certainty whether there is sufficient risk of danger to justify his incarceration in an asylum, but where shall we find an anthropologist who would dare to say from a mere somatic examination, "this man is a born criminal, it is necessary to segregate him as a preventive measure?"

There are, it is true, psychic feaures; but the psychology of the criminal is as old as crime itself, and everyone had some idea of its characteristics from ordinary observation before it was analysed methodically by alienists. As a matter of fact psychic symptoms are the only certain signs of mental anomalies, and as regards criminality the most important symptom is . . . the crime. As Tanzi has said, in every case it is the ethical standard which decides that a crime is monstrous, and that he who commits it is anomalous. This ethical standard depends on psychological determinism amongst other factors, because the greater we consider the anomaly, the internal defect—and we must suppose this to be organic although it has not yet been demonstrated—the less important do the external factors of the criminal action appear. Everyone judges in this way in everyday life and thus also do the criminal anthropologists, save that they desire to feel their ethical and psychological judgment supported by some facial asymmetry or by a striking pair of most innocent projecting ears.

If judges and experts would use an identical termino-

logy or, failing that, two parallel series of unambiguous terms, they would understand each other much more easily than is generally imagined, in spite of philosophic preconceptions. And if the experts would restrict themselves to giving concise opinions only when the data on which they are based are clear and unmistakable, and if they would confess when necessary their own uncertainties and incapacity, their opinions would certainly not awaken in the magistrates and the public that distrust which is engendered not by a hatred of everything new, an hostility to a revolutionary science, but by the obviously unwarranted pretensions of the charlatan who magnifies a scientific technique whose deficiencies are laid bare by the light of sober common sense. Too often, indeed, the opinions of the experts are characterised by a precision and a certainty which can only be compared with the decisions of the judges; there is more astuteness, if not more honesty, in the sibylline answers of the ancient pythoness and of the professional medium of to-day. The ambiguities which are inevitable between people who employ a different terminology are often improperly used in favour of the prisoner, so that rogues who are declared innocent on the ground of total mental derangement and complete irresponsibility, are sent to an asylum from which they are soon discharged because it is recognised that they are not insane.

All this does not do away with the fact that the penal systems in force to-day possess grave defects and have need of radical improvements. If they are behindhand compared with science it is not because of any theoretical preconception but because of that conservative opposition which all social institutions offer to every reform in direct proportion to its importance. The naturalistic study of crime in all its aspects will gradually indicate the best lines on which to carry out the necessary reforms, but its influence will be the more efficacious

the more carefully the science avoids any appearance of arrogance and exercises a rigorous control over itself.

It is obvious that the only measure to be adopted in the case of the insane who offend without appreciating their action is to confine them in an asylum under conditions identical with those in force for non-criminal patients, leaving the possibility and the time of their discharge absolutely in the hands of the medical authority. Their dangerous period may be only transitory and not in any way longer than that of many other insane patients.

For normal delinquents, that is for those who do not present any obvious anomalies and who have fallen into crime through the influences of their environment, punishment undoubtedly has an intimidating effect and is therefore preventive of crime. But society must not be too severe against this class, because in the majority of instances the offenders are driven into crime more by the defects of the social organisation than by any innate tendencies of their own. If from the purely judicial side the punishment can be justified as a necessary means of social defence and of prevention, adapted to the times and to the circumstances, from the moral side it is certain that it assumes the aspect of an injustice if society has not done as much as it ought and as it could to prevent the crime. To spread education, to combat want of work, to assist abandoned children, to organise work by regulating social conflicts and eliminating their hardships, to render escape from miserable family life more easy, is really to prevent crime.

An ideal punishment must never compromise the physical, psychic, or social well-being of the condemned, and yet it must retain a certain punitive character. But not one of the penal systems now in force, sad legacies of the past, can be said to reach this standard, and improvements are being made very slowly. The prisoner often leaves the prison ruined in health, and

the barbarous system of solitary confinement is frequently sufficient to give rise to an attack of insanity. The demoralisation of the prisoner will be in direct proportion to his lack of moral stability. Only those who go to prison for idealistic reasons, *e.g.*, political prisoners, can remain in possession of their full moral force at the end of their term; the offender who commits petty crimes and comes within the arm of the law through the common accidents of life, forced there by external circumstances, always emerges from prison with diminished self-respect, especially if there is the additional factor of a small capacity to resist temptation to criminal acts or perhaps a real anomaly. This must occur independently of the fact that the surroundings of imprisonment are a real school for crime because of the unavoidable promiscuity, of the moral meanness of some of the conditions which lead to incarceration, and because of the fact that the conceptions on which the penal systems are based are wrong. Thus it follows that to save the accused from prison will be the means of preventing future crimes, and with this aim in view too much importance cannot be attached to the discretion which administers justice in such a way that recidivism is avoided. The vast utility of this is just beginning to be recognised, but there is great lack of judgment and excessive timidity in its application.

The harshness, sometimes barbarous, of the prison regime cannot be attributed to any preconceived idea that cruelty towards the prisoner is necessary, or to the fact that the sentence is inspired by any feeling of revenge. At the present time legislators are drawn practically from the same class in all nations; but what a difference there is between nation and nation in the application of punishments! The most noteworthy determining factors are the standard of general wealth, the average level of life, of education, of all the bonds of social sympathy; every advance in these factors

becomes a source of improvement in the condition of prisoners. The insufficiency of social foresight reacts injuriously on prisoners as on the insane and the sick, as it does in fact on all the weak.

The theoretical necessity for segregating the criminals exhibiting marked anomalies is clear. The obstacles encountered on the practical side of this question are very great. One of the chief lies in the difficulty in discovering and estimating the degree of the anomaly. There are no means at the present time for making a certain diagnosis of constitutional immorality with the view to taking precautionary measures. Constitutional immorality is not yet entered on the list of crimes; and if a psychological examination can at an early stage discover some premonitory signs of moral obtuseness, some ethical and intellectual lacunæ which promise little that is good in the future conduct of the individual, there is no civil legislation which will allow the enforced separation from society of an element which, although it is shown to be predisposed to crime, has as yet in no way offended. At the most, these diagnostic signs will be of value after the commission of a crime to confirm the necessity of isolation. Where these same signs are absent or uncertain the only standard at our disposal is that of an obstinate repetition of the crime. But even this is not altogether reliable, because the repetition is often the outcome of the conditions of imprisonment, at least in the case of some of the lesser crimes.

But where must we send criminals who exhibit marked anomalies? To the prisons, to the asylums, or to special institutions? Many years ago, when the study of criminology was first attracting attention, it was considered justifiable to assert that there was a close affinity between crime and insanity and to demand asylum treatment for criminals, especially for the subjects of anomalies. But experience has demonstrated that these anomalous persons are not suitable for asylums, because

they themselves suffer from being associated with the really insane, and they are a source of disturbance which entirely removes the hospital character of the asylum, lowers its level, and makes it necessary to inflict restrictions on a large number of innocent patients which are useless for them but are required to prevent escapes, intrigues, revolts, or vendetta among a class of people who are only too prone to such actions. It has been suggested that judicial asylums should be established which should be devoted exclusively to the care of those criminals who are the subjects of an anomaly. But so far the efforts in this direction have not corresponded with the theoretical possibilities, and these institutions have descended to a level below that of the prisons.

It is undoubtedly a matter of considerable importance that these institutions should be improved, but it would be a mistake to confine our attention to them, and to neglect other urgent as well as interesting matters connected with houses of detention in general.

There is a psychological law that our sympathies are awakened more readily for those who have some psychical resemblance to ourselves, and in fact the sympathy is often in direct proportion to that resemblance. According to this law the born criminals amongst human beings are those who stir up our sympathies less than any others. In an insane person we often see the victim of an accidental misfortune which might happen to anyone, or at any rate we can recognise the ruins of a personality which was formerly not unlike our own. In the occasional criminal we are inclined to see a victim of unfavourable circumstances of the social environment, and we have for him that indulgence which is felt for all human weaknesses, which to comprehend is to condone. In the constitutional offender, however, we see a monstrosity, a human aberration, which cannot be interpreted as an atavistic return without insulting the beasts; we feel, therefore, that repugnance which one

has for that which is not understood, which cannot be entirely explained by psychological processes, and which at any rate does not awaken any sympathetic echo in our sentiments. It was not without reason, therefore, that some of the apostles of criminal anthropology approved so thoroughly of the penalty of death; and thus it was that it assumed the character of a clearly scientific and utilitarian expedient rather than a barbarous manifestation of social vendetta. Certainly it is not from any excess of sympathy towards criminals that the penalty of death meets with opposition. There are other very different and much more important reasons. Science would undertake too much if it presumed to be able to decide for or against the life of a citizen even if its aim was simply that of social utility. And society would make an egregious error if, for such a poor motive as economy, it ignored the much greater benefit which arises from an act of generosity and from the example of an unconditional respect for human life.

In any case, the segregation of criminals who show some anomaly must not be interpreted as being due to the idea that they approach very near to the insane, nor must it be supposed that they receive any advantages over the common criminal. Their segregation must be considered as a means of defence and of prophylaxis in favour of the occasional criminals who have much to lose and nothing to gain from contact with such perverted people. So also it must be recognised as a means of bringing a more homogeneous class under a suitable regime. The condition of these unfortunates will certainly improve in a society which is richer and more generous towards the weak and the incompatible. Their segregation must tend to lose the character of a punishment; but the non-perverted criminals have even greater right to a human treatment, and there is no reason why the so-called criminal asylums should have a more lenient organisation than the prisons.

In this rapid survey which we have given of the practical problems of psychiatry, we have been able to see how modest is the work of the medical man to-day in connection with the morbid process and its consequences; the indirect service which the principles of psychiatry can render in practice is much more extensive. As regards the regime of asylums, and still more with reference to the prophylaxis of insanity, and of crime and the treatment of criminals, any future development must be the concern not only of the alienist and the general medical man but of the whole of society. All progress in knowledge and civilisation is a contribution to the solution of the problems which psychiatry brings forward and elucidates, but which it cannot resolve unaided. If the work which has to be done is gigantic, we can encourage ourselves with the thought that it is to a certain extent the task of all good citizens. It is no mere medical work but rather one of social regeneration.

Conclusions.

In dealing with such a large subject in a volume of this size it has been necessary to pass over a large number of special questions, because to have considered them would have meant an enormous addition to the size of the book and would have encumbered it with minute data, which would be beyond the grasp of those who had not made a special study of the subject. And therefore, in merely giving a general outline of the subject, we have not been able to bestow more than a passing glance on some important and complex questions. But at any rate I hope that it has been made sufficiently clear that the study of mental diseases does not admit of any simplicist interpretations.

From a survey of the fundamental problems, we have been able to see the points at which psychiatry comes into contact with the other sciences, and also that, in common with them, our science deals for the most part with questions which are still very far from being explained at all completely.

Psychiatry cannot be reduced to the simple study of the insane and the manifestations of insanity. It must go behind these manifestations and seek to discover their cerebral mechanism, and it must, therefore, know the mechanism of the normal brain in all its aspects, anatomical, physiological, and psychological. It must learn in what ways this may be altered; from the local alterations of the psychic organ it must go on to discover the changes of other organs or of the organism generally which constitute the determining cause; and lastly, it will seek to discover the external

cause. Only in this way will it be possible to gain an idea of a real morbid process in place of a superficial grouping of symptoms.

There can be no stable science of psychiatry unless the general relations existing between consciousness and organic phenomena are established, and in order to understand this problem it is necessary to incorporate it with the more general question of the relations between consciousness and the objective world, that is to say, the intrinsic nature of knowledge. A positive knowledge regarding the parallelism between states of consciousness and the organic phenomena cannot be attained without making extensive and exact research in the field of comparative psychology, and bringing the results into close relation with the comparative anatomy of the nervous system. It is necessary to have a thorough understanding of the specific psychic organ, that is of the cerebral cortex, and in man it is especially necessary to make an analysis of the elements and a synthetic reconstruction of all the relations. This is not possible without the assistance of a perfect acquaintance with the general anatomy and physiology of the nerve elements.

From the pathological side it will be imperative to know all the alterations which these elements can undergo, the pathological manifestations of function to which these changes lead, the exact topographical distribution of the lesions, disease by disease and case by case, their primary effects and the concatenation of results which a disturbed function can produce among the elements which are still normal. It will be necessary to learn the pathological mechanism by which these changes in the elements of the psychic organ are produced, to connect them with the complicated and often obscure pathological processes of the various viscera, to follow the morbid process through its different steps in order finally to arrive at the starting point, that is to

the external cause, the primary origin of the disease, whether it affects isolated individuals or a whole stock. The grouping, the delimitation, and the pathogenetic interpretation of the separate diseases cannot be placed on a satisfactory basis unless the solution of all these questions is advanced considerably.

Guiding principles for attacking the morbid processes may possibly be gained from a theoretical knowledge of the nature and the manifestations of mental diseases in cases in which the relative simplicity of the conditions, the means of combating the morbid processes, and the natural tendency towards recovery will allow of it. In the other cases necessary suggestions for attempts at prophylaxis will be obtained which will be valuable for the protection of the species if not for the salvation of the individual. Such provision for the mentally afflicted is necessary in order that they may be protected both from the blind attacks of external influences and from the carelessness of a society which is impatient in the fight, and in which there is little room for the weak. At the same time it is necessary to defend society, to weed out the ruined and injurious elements which are all the more dangerous when their abnormality is so slight as to be barely distinguishable from the normal.

It is to this vast and varied field of inquiry, which requires to be considered from many points of view and demands a vast amount of technical knowledge, that the efforts of the alienist must be directed. An attack along the whole line of so many and such difficult and diverse problems is naturally a task which demands a collective rather than an individual effort, but every single worker will have a clearer appreciation of the particular result at which he is aiming if he can recognise its position in the general plan of scientific enquiry, and if he knows in what way his endeavours must interweave themselves with those of other workers.

This summary picture which has been outlined will

seem to some to lead to a desolate pessimism. It should certainly impress the necessity for prudence on those who are so ready to express an opinion on matters which they do not understand, and on the boasters, who are certainly not wanting in our science; but it is not a pessimistic picture. To see the problems is already a step towards solving them. To pretend not to see them is a mark of impotence.

There are those who love to fold their arms and take refuge in general and excessively simple formulæ, by which they solve this and every other problem. There are others who become dismayed before the increasing complexity of the scientific problems and who prefer to abandon themselves to the narcotic dreams of mysticism, the products of the incapacity of wearied or fossilised brains. But he who appreciates the value and the aim of science will not be discouraged if he sees that almost every solution of a scientific problem leads to the disclosure of many others, more subtle and more difficult than the first. Every advance of knowledge increases the points of contact with the unknown. Astronomical analysis now seeks for that which is beyond the stellar universe; microscopical analysis looks beyond into the ultra-microscopical; the atomic theory is lost in that of the electrons. Will this continue without end? It is possible, it is even probable. But it is well, it is inspiring that it should be so. Then the joy of research will also be without end, and research will have no other aim than to constantly go on increasing that complex of positive ideas by means of which man, more and more every day, asserts his dominion over nature.

FINIS.

ALPHABETICAL INDEX

A

B

C.

D

L

M

N

O

Manchester University Publications.

ANATOMICAL SERIES

No. I. STUDIES IN ANATOMY from the Anatomical Department of the University of Manchester. Vol. iii. Edited by the late Professor ALFRED H. YOUNG, M.B. (Edin.), F.R.C.S. Demy 8vo, pp. ix, 289, 23 plates. 10s. net.
(Publication No. 10, 1906.)

BIOLOGICAL SERIES

No. I. THE HOUSE FLY. *Musca domestica* (Linnæus). A Study of its Structure, Development, Bionomics and Economy. By C. GORDON HEWITT, D.Sc., Dominion Entomologist, Ottawa, Canada, and late Lecturer in Economic Zoology in the University of Manchester. Demy 8vo, pp. xiv. 200, 10 plates. 20s. net. (Publication No 52, 1910.)
[*Out of Print*

CELTIC SERIES

No. I. AN INTRODUCTION TO EARLY WELSH. By the late Prof. J. STRACHAN, LL.D. Demy 8vo, pp. xvi. 294. 7s. 6d. net. (Publication No. 40, 1908.)

No. II. THE LANGUAGE OF THE ANNALS OF ULSTER. By TOMÁS O'MAILLE, M.A., Professor of Irish in University College, Galway. Demy 8vo. pp. xiii, 220. 7s. 6d. net.
(Publication No. 53, 1910.)

No. III. A GLOSSARY TO THE BLACK BOOK OF CHIRK MANUSCRIPT OF THE WELSH LAWS. By TIMOTHY LEWIS, M.A., Lecturer in Welsh and Comparative Philology in University College of Wales, Aberystwyth. [*In the Press*.

CLASSICAL SERIES

No. I. A STUDY OF THE BACCHAE OF EURIPIDES. By G. NORWOOD, M.A., Professor of Greek in University College, Cardiff, and late Assistant Lecturer in Classics in the University of Manchester. Demy 8vo, pp. xx. 188. 5s. net. (Publication No. 31, 1908.)

No. II. THE AUTHORSHIP OF THE PLATONIC EPISTLES. By R. HACKFORTH, M.A., Fellow and Classical Lecturer of Sidney Sussex College, Cambridge, and late Assistant Lecturer in Classics in the University of Manchester. Cr. 8vo, pp. ix. 199. Price 6s. net. (Publication No. 72, 1913.)

COMPARATIVE LITERATURE SERIES.

CASTELVETRO'S THEORY OF POETRY. By H. B. CHARLTON, B.A., Assistant Lecturer in English Language and Literature. [*In the Press.*

ECONOMIC SERIES

No. I. THE LANCASHIRE COTTON INDUSTRY. By S. J. CHAPMAN, M.A., M.Com., Stanley Jevons Professor of Political Economy and Dean of the Faculty of Commerce. Demy 8vo, pp. vii. 309. 7s. 6d. net.
(Publication No. 4, 1904.)

(GARTSIDE REPORT, No. 1.)
No. II. COTTON SPINNING AND MANUFACTURING IN THE UNITED STATES OF AMERICA. By T. W. UTTLEY, B.A., Gartside Scholar. Demy 8vo, pp. xii. 70. 1s. net.
(Publication No. 8, 1905.)

(GARTSIDE REPORT, No. 2.)
No. III. SOME MODERN CONDITIONS AND RECENT DEVELOPMENTS IN IRON AND STEEL PRODUCTION IN AMERICA, being a Report to the Gartside Electors, on the results of a Tour in the U.S.A. By FRANK POPPLEWELL, B.Sc., Gartside Scholar. Demy 8vo, pp. xii. 126. 1s. net.
(Publication No. 21, 1906.)

(GARTSIDE REPORT, No. 3.)
No. IV. ENGINEERING AND INDUSTRIAL CONDITIONS IN THE UNITED STATES. By FRANK FOSTER, M.Sc., Gartside Scholar. Demy 8vo, pp. ix. 106. 1s. net.
(Publication No. 22, 1906.)

No. V. THE RATING OF LAND VALUES. By J. D. CHORLTON, M.Sc. Demy 8vo, pp. viii. 177. 3s. 6d. net.
(Publication No. 23, 1907.)

(GARTSIDE REPORT, No. 4.)
No. VI. DYEING IN GERMANY AND AMERICA. By SYDNEY H. HIGGINS, M.Sc., Gartside Scholar. Demy 8vo, pp. xiii. 112. 1s. net. (Publication No. 24, 1907.)

No. VII. THE HOUSING PROBLEM IN ENGLAND. By ERNEST RITSON DEWSNUP, M.A., Professor of Railway Economics in the University of Chicago. Demy 8vo, pp. vii. 327. 5s. net. (Publication No. 25, 1907.)

ECONOMIC SERIES

(Gartside Report, No. 5.)

No. VIII. AMERICAN BUSINESS ENTERPRISE. By Douglas Knoop, M.A., Gartside Scholar, Lecturer in Economics in the University of Sheffield, and late Assistant Lecturer in Economics in the University of Manchester. Demy 8vo, pp. viii. 128. 1s. 6d. net.
(Publication No. 30, 1907.)

(Gartside Report, No. 6.)

No. IX. THE ARGENTINE AS A MARKET. By N. L. Watson, M.A., Gartside Scholar. Demy 8vo, pp. viii. 64. 1s. net. (Publication No. 33, 1908.)

(Gartside Report, No. 7.)

No. X. SOME ELECTRO-CHEMICAL CENTRES. By J. N. Pring. D.Sc., Gartside Scholar, and Lecturer and Demonstrator in Electro-Chemistry. Demy 8vo, pp. xiv. 137. 1s. 6d. net. (Publication No. 41, 1908.)

(Gartside Report, No. 8.)

No. XI. CHEMICAL INDUSTRY ON THE CONTINENT. By Harold Baron, B.Sc., Gartside Scholar. Demy 8vo, pp. xi. 71. 1s. 6d. net. (Publication No. 44, 1909.)

No. XII. UNEMPLOYMENT. By S. J. Chapman, M.A., M.Com., Stanley Jevons Professor of Political Economy and Dean of the Faculty of Commerce, and H. M. Hallsworth, M.A., B.Sc., Professor of Economics, Armstrong College, Newcastle-on-Tyne, and late Assistant Lecturer in Economics in the University of Manchester. Demy 8vo, pp. xvi. 164. 2s. net, paper, 2s. 6d. net, cloth.
(Publication No. 45, 1909.)

(Gartside Report, No. 9.)

No. XIII. THE COTTON INDUSTRY IN SWITZERLAND, VORARLBERG AND ITALY. A Technical and Economic Study. By S. L. Besso, LL.B., Gartside Scholar. Demy 8vo, pp. xv. 229. 3s. 6d. net. (Publication No. 54, 1910.)

(Gartside Report, No. 10.)

No. XIV. THE GERMAN COTTON INDUSTRY. By R. M. R. Dehn, B.A., Gartside Scholar. Demy 8vo, pp. viii. 102. 2s. net. (Publication No. 78, 1913.)

EDUCATIONAL SERIES

No. I. CONTINUATION SCHOOLS IN ENGLAND AND ELSEWHERE. Their place in the Educational System of an Industrial and Commercial State. By MICHAEL E. SADLER, M.A., LL.D., Vice-Chancellor of the University of Leeds, and late Professor of the History and Administration of Education in the University of Manchester. Demy 8vo, pp. xxvi. 779. 8s. 6d. net. (Publication No. 29, 1907.)

No. II. THE DEMONSTRATION SCHOOLS RECORD. No. I. Being Contributions to the Study of Education from the Department of Education in the University of Manchester. By J. J. FINDLAY, M.A., Ph.D., Sarah Fielden Professor of Education. Demy 8vo, pp. viii. 126. 1s. 6d. net. (Publication No. 32, 1908.)

No. III. THE TEACHING OF HISTORY IN GIRLS' SCHOOLS IN NORTH AND CENTRAL GERMANY. A Report by EVA DODGE, M.A., Gilchrist Student. Demy 8vo, pp. x. 149. 1s. 6d. net. (Publication No. 34, 1908.)

No. IV. THE DEPARTMENT OF EDUCATION IN THE UNIVERSITY OF MANCHESTER, 1890-1911. Demy 8vo, 146 pp., with 12 plates. 1s. 6d. net, paper; 2s. 6d. net, cloth. (Publication No. 58, 1911.)

Published in commemoration of the twenty-first anniversary of the Education Department.

No. V. OUTLINES OF EDUCATION COURSES IN MANCHESTER UNIVERSITY. Demy 8vo, pp. viii. 190. 3s. net. (Publication No. 61. 1911.)

No. VI. THE STORY OF THE MANCHESTER HIGH SCHOOL FOR GIRLS, 1871-1911. By SARA A. BURSTALL, M.A., Head Mistress, Special Lecturer in Education in the University. Demy 8vo, pp. xx. 214, with 18 Plates. 5s. net. (Publication No. 63, 1911.)

No. VII. THE DEMONSTRATION SCHOOL RECORD, No. II. The Pursuits of the Fielden School. Edited by J. J. FINDLAY, M.A., Ph.D., Sarah Fielden Professor of Education. Demy 8vo, pp. xxxvi. 284, 8 Plates. 5s. net. (Publication No. 75, 1913.)

ENGLISH SERIES

No. I. THE LITERARY PROFESSION IN THE ELIZABETHAN AGE. By Ph. Sheavyn, M.A., D.Lit., Special Lecturer in English Literature and Senior Tutor for Women Students; Warden of the Hall of Residence for Women Students. Demy 8vo, pp. xii. 221. 5s. net.
(Publication No. 49, 1909.)

No. II. BEOWULF: Edited, with Introduction, Bibliography, Notes, Glossary, and Appendices, by W. J. Sedgefield. Litt.D., Professor of English Language. Second edition, revised and enlarged. Demy 8vo, pp. liii. 271. 9s. net.
(Publication No. 84, 1913.)

No. III. PATIENCE: A West Midland Poem of the Fourteenth Century. Edited, with Introduction, Bibliography, Notes, and Glossary, by Hartley Bateson, B.A., Faulkner Fellow. Cr. 8vo, pp. x. 150. 4s. 6d. net.
(Publication No. 70, 1912.)

No. IV. THE EARLY LIFE AND DEVELOPMENT OF GEORGE ELIOT. By Mary H. Deakin, M.A., formerly John Bright Fellow. With an Introductory Note by C. H. Herford, Litt.D., Professor of English Literature. Demy 8vo, pp. xviii. 188. 6s. net. (Publication No. 71, 1913.)

Nos. V and VI. THE POETICAL WORKS OF WILLIAM DRUMMOND OF HAWTHORNDEN. With "A Cypresse Grove." Edited, with Introduction, Bibliography, Iconography, and Notes, also a List of Variants in the different editions hitherto published, by L. E. Kastner, M.A., Professor of French Language and Literature. Illustrated by 22 fac-simile Reproductions of Original Title-pages and 7 Portraits of the Author, all reproduced in Collotype, many of them for the first time. Two vols., demy 8vo. Vol. I, pp. cxxiv. 254; Vol. II, pp. xx. 434. 21s. net.
(Publication Nos. 79 and 80, 1913.)

GERMANIC SERIES

No. I. VOWEL ALLITERATION IN THE OLD GERMANIC LANGUAGES. By E. Classen, M.A., Assistant Lecturer in English Language and Literature. Demy 8vo, pp. xvi. 90. 3s. 6d. net. (Publication No. 81, 1913.)

HISTORICAL SERIES

No. I. MEDIÆVAL MANCHESTER AND THE BEGINNINGS OF LANCASHIRE. By JAMES TAIT, M.A., Professor of Ancient and Mediæval History. Demy 8vo, pp. x. 211, with 3 Illustrations. 7s. 6d. net.
(Publication No. 3, 1904.)

No. II. INITIA OPERUM LATINORUM QUAE SAECULIS XIII., XIV., XV. ATTRIBUUNTUR. By A. G. LITTLE, M.A., Lecturer in Palæography. Demy 8vo, pp. xiii. 273 (interleaved). (Out of print.) (Publication No. 5, 1904.)

No. III. THE OLD COLONIAL SYSTEM. By GERALD BERKELEY HERTZ, M.A., B.C.L., Lecturer in Colonial History. Demy 8vo, pp. xi. 232. 5s. net. (Publication No. 7, 1905.)

No. IV. STUDIES OF ROMAN IMPERIALISM. By W. T. ARNOLD, M.A. Edited by EDWARD FIDDES, M.A., Lecturer in Ancient History, with Memoir of the Author by Mrs. HUMPHRY WARD and C. E. MONTAGUE. With a Photogravure portrait of W. T. Arnold. Demy 8vo, pp. cxxiii. 281. 7s. 6d. net. (Publication No. 16, 1906.)
The Memoir may be had separately, price 2s. 6d. net.

No. V. CANON PIETRO CASOLA'S PILGRIMAGE TO JERUSALEM IN THE YEAR 1494. By M. MARGARET NEWETT, B.A., formerly Jones Fellow. Demy 8vo, pp. viii. 427, with 3 Illustrations. 7s. 6d. net.
(Publication No. 26, 1907.)

No. VI. HISTORICAL ESSAYS. Edited by T. F. TOUT, M.A., F.B.A., Professor of Mediæval and Modern History, and JAMES TAIT, M.A., Professor of Ancient and Mediæval History. Demy 8vo, pp. xv. 557. 6s net. Reissue of the Edition of 1902 with index and New Preface.
(Publication No. 27, 1907.)
The index can be purchased separately, price 6d. net.

No. VII. STUDIES SUPPLEMENTARY TO STUBBS' CONSTITUTIONAL HISTORY. Vol. i. By CH. PETIT-DUTAILLIS, Litt.D., rector of the University of Grenoble. Translated from the French by W. E. RHODES, M.A., formerly Jones Fellow, and edited by Prof. JAMES TAIT, M.A. Demy 8vo, pp. xiv. 152. 4s. net.
(Publication No. 38, 1908. Second Edition, 1911.)

No. VIII. MALARIA AND GREEK HISTORY. By W. H. S. JONES, M.A. To which is added the History of Greek Therapeutics and the Malaria Theory by E. T. WITHINGTON, M.A., M.B. Demy 8vo, pp. xii. 176. 5s. net.
(Publication No. 43, 1909.)

HISTORICAL SERIES

No. IX. HANES GRUFFYDD AP CYNAN. The Welsh text with translation, introduction, and notes by ARTHUR JONES, M.A., Lecturer in Modern History in Birkbeck College, University of London, and late Assistant Lecturer in History in the University of Manchester. Demy 8vo, pp. viii. 204, with 3 Illustrations. 6s. net.
(Publication No. 50, 1910.)

No. X. THE CIVIL WAR IN LANCASHIRE. By ERNEST BROXAP, M.A. Demy 8vo, pp. xv. 226, 6 plates. 7s. 6d. net. (Publication No. 51, 1910.)

No. XI. A BIOGRAPHY OF THOMAS DEACON, THE MANCHESTER NON-JUROR. By HENRY BROXAP, M.A. Demy 8vo, pp. xix. 215, 2 plates. 7s. 6d. net.
(Publication No. 59, 1911.)

No. XII. THE EJECTED OF 1662: Their Predecessors and Successors in Cumberland and Westmorland. By B. NIGHTINGALE, M.A. In two volumes, demy 8vo, pp. xxiv. 1490. 28s. net. (Publication No. 62, 1911.)

No. XIII. GERMANY IN THE NINETEENTH CENTURY. Lectures by J. HOLLAND ROSE, Litt.D., C. H. HERFORD, Litt.D., E. C. K. GONNER, M.A., and M. E. SADLER, M.A., LL.D. With an Introductory Note by Viscount HALDANE. Demy 8vo, pp. xxi. 142. 2s. 6d. net. Second Edition.
(Publication No. 65, 1912.)

No. XIV. A HISTORY OF PRESTON IN AMOUNDERNESS. By H. W. CLEMESHA, M.A. Demy 8vo., pp. xii. 344, 5 maps. 7s. 6d. net. (Publication No. 67, 1912.)

No. XV. A SHORT HISTORY OF TODMORDEN. By J. HOLDEN, M.A. Crown 8vo, pp. xiv. 242, 25 full-page plates and illustrations in the text. Cloth, 2s. net; or cloth extra, 2s. 6d. net. (Publication No. 68, 1912.)

No. XVI. THE LOSS OF NORMANDY, 1189–1204. Studies in the History of the Angevin Empire. By F. M. POWICKE, M.A., Fellow of Merton College, Oxford, Professor of Modern History in the Queen's University, Belfast, and late Langton Fellow and Lecturer in History in the University of Manchester. Demy 8vo, pp. xx. 604, With 6 maps. 15s. net. (Publication No. 73, 1913.)

Nos. XVII and XVIII. IRELAND UNDER THE COMMONWEALTH, Being a Selection of Documents relating to the Government of Ireland from 1651–1659. Edited, with Historical Introduction and Notes, by ROBERT DUNLOP, M.A., Lecturer in Irish History. Two vols. Vol. I, pp. clxxvi. 282; Vol. II, pp. lxxviii. 471. 25s. net.
(Publication Nos. 76 and 77, 1913.)

HISTORICAL SERIES

No. XIX. THE NAVAL MUTINIES OF 1797. By CONRAD GILL, M.A., Assistant Lecturer in History. Demy 8vo, pp. xx. 410, with 2 maps. 10s. 6d. net.
(Publication No. 83, 1913.)

MEDICAL SERIES.

No. I. SKETCHES OF THE LIVES AND WORK OF THE HONORARY MEDICAL STAFF OF THE ROYAL INFIRMARY. From its foundation in 1752 to 1830, when it became the Royal Infirmary. By EDWARD MANSFIELD BROCKBANK, M.D., M.R.C.P. Crown 4to. (illustrated), pp. vii. 311. 15s. net. (Publication No. 1, 1904.)

No. II. PRACTICAL PRESCRIBING AND DISPENSING. For Medical Students. By WILLIAM KIRKBY, sometime Lecturer in Pharmacognosy in the Owens College, Manchester. Crown 8vo, pp. iv. 194. 5s. net.
(Publication No. 2, 1904, Second Edition, 1906.)

No. III. HANDBOOK OF SURGICAL ANATOMY. By G. A. WRIGHT, B.A., M.B. (Oxon.), F.R.C.S., Emeritus Professor of Systematic Surgery, and C. H. PRESTON, M.D., F.R.C.S., L.D.S., Lecturer on Dental Anatomy; Assistant Dental Surgeon to the Victoria Dental Hospital of Manchester. Crown 8vo, pp. ix. 205. 5s. net. Second edition.
(Publication No. 6, 1905.)

No. IV. A COURSE OF INSTRUCTION IN OPERATIVE SURGERY in the University of Manchester. By WILLIAM THORBURN, M.D., B.S. (Lond.), F.R.C.S., Professor of Operative Surgery. Crown 8vo, pp. 75 (interleaved), 26 Figures in the Text. 2s. 6d. net.
(Publication No. 11, 1906.)

No. V. A HANDBOOK OF LEGAL MEDICINE. By W. SELLERS, M.D. (London), Professor of Forensic Medicine. With 7 illustrations. Crown 8vo, pp. vii. 233. 7s. 6d. net.
(Publication No. 14, 1906.)

No. VI. A CATALOGUE OF THE PATHOLOGICAL MUSEUM OF THE UNIVERSITY OF MANCHESTER. Edited by J. LORRAIN SMITH, M.A., M.D. (Edin.), Professor of Pathology in the University of Edinburgh; late Professor of Pathology in the University of Manchester. Crown 4to, 1260 pp. 7s. 6d. net. (Publication No. 15, 1906.)

No. VII. HANDBOOK OF DISEASES OF THE HEART. By GRAHAM STEELL, M.D., F.R.C.P., Emeritus Professor of Medicine, and Physician to the Manchester Royal Infirmary. Crown 8vo, pp. xii. 389, 11 plates (5 in colours), and 100 illustrations in the text. 7s. 6d. net.
(Publication No. 20, 1906.)

MEDICAL SERIES

No. VIII. JULIUS DRESCHFELD. IN MEMORIAM. Medical Studies by his colleagues and pupils at the Manchester University and the Royal Infirmary. Imperial 8vo, pp. vi. 246. With a Photogravure and 43 Plates. 10s. 6d. net. (Publication No. 35, 1908.)

No. IX. HANDBOOK OF INFECTIOUS DISEASES. By R. W. MARSDEN, M.D. Crown 8vo, pp. vi. 296. 5s. net. (Publication No. 39, 1908.)

No. X. LECTURES ON THE PATHOLOGY OF CANCER. By CHARLES POWELL WHITE, M.A., M.D., F.R.C.S., Special Lecturer in Pathology. Imperial 8vo, pp. x. 83, 33 plates. 3s. 6d. net. (Publication No. 42, 1908.)

No. XI. SEMMELWEIS: HIS LIFE AND HIS DOCTRINE. A chapter in the history of Medicine. By the late Professor Sir WILLIAM J. SINCLAIR, M.A., M.D. Imperial 8vo, pp. x. 369, 2 plates. 7s. 6d. net. (Publication No. 46, 1909.)

No. XII. MODERN PROBLEMS IN PSYCHIATRY. By E. LUGARO, Professor of Nervous and Mental Diseases in the University of Modena. Translated from the Italian by DAVID ORR, M.D., Assistant Medical Officer and Pathologist to the County Asylum, Prestwich; and R. G. ROWS, M.D., Assistant Medical Officer and Pathologist to the County Asylum, Lancaster. With an Introduction by Sir T. S. CLOUSTON, M.D., late Physician Superintendent, Royal Asylum, Morningside, and Lecturer on Mental Diseases in Edinburgh University. Imperial 8vo, pp. viii. 305, 8 plates. 7s. 6d. net. (Publication No. 47, 1909.)
(Second Edition, 1913.)

No. XIII. FEEBLEMINDEDNESS IN CHILDREN OF SCHOOL AGE. By C. PAGET LAPAGE, M.D., M.R.C.P., Lecturer in Diseases of Children. With an Appendix on Treatment and Training by MARY DENDY, M.A. Crown 8vo, pp. xvi. 359, 12 plates. 5s net.
(Publication No. 57, 1911.)

No. XIV. DISEASES OF THE NERVOUS SYSTEM. By JUDSON S. BURY, M.D. (Lond.), F.R.C.P., late Professor of Clinical Medicine. Demy 8vo, pp. xx. 788, with 216 Illustrations. 15s. net. (Publication No. 66, 1912.)

THE CLINICAL ANATOMY OF THE ALIMENTARY CANAL. By T. WINGATE TODD, M.B., Ch.B., F.R.C.S., Professor of Anatomy in the Western Reserve University, Cleveland, U.S.A.; late Lecturer in Anatomy in the University of Manchester. [*In Preparation.*

PHYSICAL SERIES

No. I. THE PHYSICAL LABORATORIES OF THE UNIVERSITY OF MANCHESTER. A record of 25 years' work. Demy 8vo, pp. viii. 142, with a Photogravure, 10 Plates, and 4 Plans. 5s. net.

(Publication No. 13, 1906.)

This volume contains an illustrated description of the Physical Electrical Engineering, and Electro-Chemistry Laboratories of the Manchester University, also a complete Biographical and Bibliographical Record of those who have worked in the Physics Department of the University during the past 25 years.

No. II. LABORATORY EXERCISES IN PHYSICAL CHEMISTRY. By J. N. PRING, D.Sc., Lecturer and Demonstrator in Electro-Chemistry. Crown 8vo, pp. xiv. 164, with 27 diagrams. 4s. net.

(Publication No. 64, 1912.)

PUBLIC HEALTH SERIES

No. I. ARCHIVES OF THE PUBLIC HEALTH LABORATORY OF THE UNIVERSITY OF MANCHESTER. Edited by A. SHERIDAN DELEPINE, M.Sc., M.B., Ch.M., Director of the Laboratory and Proctor Professor of Comparative Pathology and Bacteriology. Crown 4to., pp. iv. 451. £1. 1s. net. (Publication No. 12, 1906.)

THEOLOGICAL SERIES

No. I. INAUGURAL LECTURES delivered during the Session 1904-5, by the Professors and Lecturers of the Faculty of Theology, viz. :—

Prof. T. F. Tout, M.A.; Prof. A. S. Peake, B.D.; Prof. H. W. Hogg, M.A.; Prof. T. W. Rhys Davids, LL.D.; Rev. W. F. Adeney, D.D.; Rev. A. Gordon, M.A.; Rev. L. Hassé, B.D.; Rev. Canon E. L. Hicks, M.A.; Rev. H. D. Lockett, M.A.; Rev. R. Mackintosh, D.D.; Rev. J. T. Marshall, D.D.; Rev. J. H. Moulton, D.Litt.

Edited by A. S. PEAKE, B.D., Dean of the Faculty. Demy 8vo, pp. xi. 296. 7s. 6d. net.

(Publication No. 9, 1905.)

No. II. THE ARIAN MOVEMENT IN ENGLAND. By Rev. J. HAY COLLIGAN, M.A. Crown 8vo, pp. x. 176. 3s. 6d. net.

(Publication No. 74, 1913.)

LECTURES

No. I. GARDEN CITIES (Warburton Lecture). By RALPH NEVILLE, K.C. 6d. net. (Lecture No. 1, 1905.)

No. II. THE BANK OF ENGLAND AND THE STATE (A Lecture). By Sir FELIX SCHUSTER. 6d. net.

(Lecture No. 2, 1905.)

LECTURES

No. III. BEARING AND IMPORTANCE OF COMMERCIAL TREATIES IN THE TWENTIETH CENTURY. By Sir THOMAS BARCLAY. 6d. net. (Lecture No. 3, 1906.)

No. IV. THE SCIENCE OF LANGUAGE AND THE STUDY OF THE GREEK TESTAMENT (A Lecture). By JAMES HOPE MOULTON, M.A., Litt.D. 6d. net. (Lecture No. 4. 1906.)

No. V. THE GENERAL MEDICAL COUNCIL: ITS POWERS AND ITS WORK (A Lecture). By DONALD MACALISTER, M.A., M.D., B.Sc., D.C.L., LL.D. 6d. net. (Lecture No. 5, 1906.)

No. VI. THE CONTRASTS IN DANTE (A Lecture). By the Hon. WILLIAM WARREN VERNON, M.A. 6d. net. (Lecture No. 6, 1906.)

No VII. THE PRESERVATION OF PLACES OF INTEREST OR BEAUTY (A Lecture). By Sir ROBERT HUNTER. 6d. net. (Lecture No. 7, 1907.)

No. VIII. ON THE LIGHT THROWN BY RECENT INVESTIGATIONS ON ELECTRICITY ON THE RELATION BETWEEN MATTER AND ETHER (Adamson Lecture). By J. J. THOMSON, D.Sc., F.R.S. 6d. net. (Lecture No. 8, 1908.)

No. IX. HOSPITALS, MEDICAL SCIENCE, AND PUBLIC HEALTH (A Lecture). By Sir CLIFFORD ALLBUTT, K.C.B., M.D. (Cantab.). 6d. net. (Lecture No. 9, 1908.)

No. X. ENGLISH POETRY AND GERMAN PHILOSOPHY IN THE AGE OF WORDSWORTH (Adamson Lecture). By A. C. BRADLEY, Litt.D. 6d. net. (Lecture No. 10, 1909.)

No. XI. THE EVOLUTION OF SURGERY. By WILLIAM THORBURN, F.R.C.S. 6d. net. (Lecture No. 11, 1910.)

No. XII. LEIBNIZ AS A POLITICIAN. By A. W. WARD, Litt.D., F.B.A. 6d. net. (Lecture No. 12, 1911.)

Nos. XIII and XIV. OLD TOWNS AND NEW NEEDS, by PAUL WATERHOUSE, M.A., F.R.I.B.A., and THE TOWN EXTENSION PLAN, by RAYMOND UNWIN, F.R.I.B.A. (Warburton Lectures for 1912.) 1 volume. Illustrated. 1s. net. (Lectures Nos. 13 and 14, 1912.)

No. XV. UNIVERSITY EDUCATION FOR WOMEN. (A Lecture.) By Mrs. HENRY SIDGWICK, LL.D. 6d. net. (Lecture No. 15, 1913.)

No. XVI. THE DISTINCTION BETWEEN MIND AND ITS OBJECTS (Adamson Lecture). By BERNARD BOSANQUET, M.A., F.B.A. Paper 1s. net, cloth 1s. 6d. net. (Lecture No. 16, 1913.)

No. XVII. EDUCATION AS THE TRAINING OF PERSONALITY. An Inaugural Lecture. By H. BOMPAS SMITH, M.A. 6d. net. (Lecture No. 17, 1913.)

Publications relating to the University of Manchester issued at the University Press.

CALENDAR OF THE UNIVERSITY OF MANCHESTER.

Session 1904-5. Demy 8vo, 1100 pp. 3s. net. (Publication No. 17.)

Session 1905-6. Demy 8vo, 1200 pp. 3s. net. (Publication No. 18.)

Session 1906-7. Demy 8vo, 1300 pp. 3s. net. (Publication No. 19.)

Session 1907-8. Demy 8vo, 1400 pp. 3s. net. (Publication No. 28.)

Session 1908-9. Demy 8vo, 1460 pp. 3s. net (Publication No. 37.)

Session 1909-10. Demy 8vo, 1470 pp. 3s. net. (Publication No. 48.)

Session 1910-11. Demy 8vo, 1550 pp. 3s. net. (Publication No. 56.)

Session 1911-12. Demy 8vo, 1570 pp. 3s. net. (Publication No. 60.)

Session 1912-13. Demy 8vo, 946 pp. 2/6 net. (Publication No. 69.)

Session 1913-14. Demy 8vo, 2/6 net. (Publication No. 85.)

THE OWENS COLLEGE, ITS FOUNDATION AND ITS GROWTH AND ITS CONNECTION WITH THE VICTORIA UNIVERSITY. By JOSEPH THOMSON. With 7 illustrations. Demy 8vo, pp. xvi. 671. 18s. net. (1886.)

MANCHESTER UNIVERSITY DIARY. Published annually at the beginning of each academic year. 1s. net.

THE UNIVERSITY OF MANCHESTER MEDICAL SCHOOL. pp. 56, with 17 illustrations. Cloth 6d. net.

THE UNIVERSITY MAGAZINE. Published fortnightly during Term. 3d. each number. Annual subscription, 4s. post free.

POEMS FROM "THE UNIVERSITY MAGAZINE," from the date of its inauguration in 1868 up to and including the present year. Edited by H. B. CHARLTON, B.A., and O. C. de C. ELLIS, B.Sc. One volume. Crown 8vo, about 250 pp. 4s. 6d. net. [*In the Press.*

STUDIES FROM THE ANATOMICAL DEPARTMENT. Edited by Professor A. H. YOUNG, F.R.C.S. Demy 8vo, paper covers.

Vol. I. Pp. iv. 257, with 7 plates. 7s. 6d. net. (1891.)
Vol. II. Pp. vi. 257, with 6 plates. 7s. 6d. net. (1900.)
For Vol. III, see page 1.

STUDIES FROM THE BIOLOGICAL LABORATORIES.

Vol. I. Pp. viii. 330, with 14 plates, edited by Professor MILNES MARSHALL. 7s. 6d. net. (1886.)

Vol. II. Pp. iv, 268, with 15 plates, edited by Professor MILNES MARSHALL. 7s. 6d. net. (1890.)

Vol. III. Pp. viii. 288, with 16 plates, edited by Professor S. J. HICKSON. 7s. 6d. net. (1895.)

STUDIES FROM THE PHYSICAL AND CHEMICAL LABORATORIES. Vol. I. Pp. viii. 320, illustrated. Edited by Professors A. SCHUSTER and H. B. DIXON. 5s. net. (1893.)

EXAMINATION PAPERS SET FOR THE VARIOUS DEGREES AND SCHOLARSHIPS OF THE UNIVERSITY are now published annually, starting from Session 1911—1912, at the following prices :—

Scholarships aud Prizes - - -	Price 6d. net;	Post 2d.
Faculties of Law, Music and Theology	,, 6d. ,,	,, 2d.
Entrance Scholarships - - -	,, 6d. ,,	,, 2d.
Faculties of Art and Commerce -	,, 1/- ,,	,, 6d.
Department of Education - -	,, 4d. ,,	,, 1d.
Faculty of Medicine -	,, 1/- ,,	,, 2d.
Faculties of Science and Technology -	,, 1/- ,,	,, 4d.

THE CATALOGUE OF THE CHRISTIE COLLECTION. Edited by C. W. E. LEIGH, Librarian to the University. [*In the Press.*

THE REGISTER OF GRADUATES OF THE UNIVERSITY OF MANCHESTER UP TO JULY, 1908. 2s. 6d. net; cloth, 3s. 6d. net. (Publication No. 36.)

Publications of the John Rylands Library issued at the University Press.

THE JOHN RYLANDS LIBRARY: Memorial of the Inauguration, 6th October, 1899. [Printed for private circulation.] 8vo, pp. 24.

CATALOGUE OF THE MANUSCRIPTS, BOOKS, AND BOOKBINDINGS EXHIBITED AT THE OPENING OF THE JOHN RYLANDS LIBRARY, MANCHESTER, 6th October, 1899. 8vo, pp. 42. [*Out of Print.*

CATALOGUE OF THE PRINTED BOOKS AND MANUSCRIPTS IN THE JOHN RYLANDS LIBRARY, MANCHESTER. 1899. 3 vols. 4to. 31s. 6d. net.

CATALOGUE OF BOOKS IN THE JOHN RYLANDS LIBRARY . . . PRINTED IN ENGLAND, SCOTLAND, AND IRELAND, AND OF BOOKS IN ENGLISH PRINTED ABROAD, TO THE END OF THE YEAR 1640. 1895. 4to, pp. iii. 147. 10s. 6d. net.

THE ENGLISH BIBLE IN THE JOHN RYLANDS LIBRARY, 1525 to 1640. With 26 facsimiles and 39 engravings. [Printed for private circulation.] 1899. Folio, pp. xvi. 275. In levant Morocco, 5 guineas net.

THE JOHN RYLANDS LIBRARY: A Brief Description of the Building and its Contents, with a Descriptive List of the Works Exhibited in the Main Library. [Printed for private circulation.] July, 1902. 8vo, pp. 48. [*Out of Print.*

JOHN RYLANDS LIBRARY. . . . JOHANN GUTENBERG AND THE DAWN OF TYPOGRAPHY IN GERMANY. Lecture by the Librarian, 14th October, 1903. (Synopsis of Lecture.—List of works exhibited . . . to illustrate the work of the first typographers in Germany. . .—A selection from the works in the John Rylands Library bearing upon the subject.) 1903. 8vo, pp. 15. [*Out of Print.*

THE JOHN RYLANDS LIBRARY: THE MOVEMENT OF OLD TESTAMENT SCHOLARSHIP IN THE NINETEENTH CENTURY. [Synopsis of] a lecture by Prof. A. S. Peake, . . . 11th November, 1903—Some leading dates in Pentateuch criticism, 1903. 8vo, pp. 8. [*Out of Print.*

WORKS UPON THE STUDY OF GREEK AND LATIN PALÆOGRAPHY AND DIPLOMATIC IN THE JOHN RYLANDS LIBRARY. . . . Reprinted from the "Quarterly Bulletin of the John Rylands Library." 1903. 4to, pp. 16. [*Out of Print.*

THE JOHN RYLANDS LIBRARY. . . . Catalogue of an Exhibition of Bibles illustrating the history of the English versions from Wiclif to the present time. Including the personal copies of Queen Elizabeth, General Gordon, and Elizabeth Fry. 1904. 8vo, pp. 32. [*Out of Print.*

THE JOHN RYLANDS LIBRARY. . . . Catalogue of the Manuscripts and Printed Books exhibited on the occasion of the visit of the National Council of the Evangelical Free Churches. 1905. 8vo, pp. 38. [*Out of Print.*

THE JOHN RYLANDS LIBRARY. . . . A brief historical description of the Library and its contents, with Catalogue of the selection of early printed Greek and Latin Classics exhibited on the occasion of the visit of the Classical Association. . . . 1906. 8vo, pp. 89. Illus. 1s. net.

THE JOHN RYLANDS LIBRARY. . . . Catalogue of an Exhibition of Bibles illustrating the history of the English versions from Wiclif to the present time, including the personal copies of Queen Elizabeth, Elizabeth Fry, and others. 1907. 8vo, pp. vii. 55. [*Out of Print.*

THE JOHN RYLANDS LIBRARY. . . . Catalogue of the Selection of Books and Broadsides illustrating the early history of printing exhibited on the occasion of the visit of the Federation of Master Printers and Allied Trades. 1907. 8vo, pp. vi. 34. [*Out of Print.*

THE JOHN RYLANDS LIBRARY. . . . A brief historical description of the Library and its contents. 1907. 8vo, pp. 53. Illus. [*Out of Print.*

THE JOHN RYLANDS LIBRARY. . . . Catalogue of an Exhibition of Illuminated Manuscripts, principally Biblical and Liturgical, on the occasion of the Church Congress. 1908. 8vo, pp. vi. 82. 6d. net.

THE JOHN RYLANDS LIBRARY. . . . Catalogue of an Exhibition of original editions of the principal works of John Milton arranged in celebration of the tercentenary of his birth. 1908. 8vo, pp. 24. 6d. net.

THE JOHN RYLANDS LIBRARY. . . . Catalogue of an Exhibition of the works of Dante Alighieri [with list of a selection of works on the study of Dante]. 1909. 8vo, pp. xii. 55. 6d. net.

THE JOHN RYLANDS LIBRARY. . . . Catalogue of an Exhibition of original editions of the principal English Classics [with list of works for the study of English literature]. 1910. 8vo, pp. xvi. 86. 6d. net.

A CLASSIFIED CATALOGUE OF THE WORKS ON ARCHITECTURE AND THE ALLIED ARTS IN THE PRINCIPAL LIBRARIES OF MANCHESTER AND SALFORD, with Alphabetical author list and subject index. Edited for the Architectural Committee of Manchester by Henry Guppy and Guthrie Vine. 1909. 8vo, pp. xxv. 310. 3s. 6d. net, or interleaved 4s. 6d. net.

THE JOHN RYLANDS LIBRARY. . . . An analytical catalogue of the contents of the two editions of "An English Garner," compiled by Edward Arber (1877-97), and rearranged under the editorship of Thomas Seccombe (1903-04). 1909. 8vo, pp. viii. 221. 1s. net.

BULLETIN OF THE JOHN RYLANDS LIBRARY. Vol. i. (1903-08). 4to, pp. 468. 6s. net.

AN ACCOUNT OF A COPY FROM THE FIFTEENTH CENTURY [now in the John Rylands Library] of a map of the world engraved on metal, which is preserved in Cardinal Stephen Borgia's Museum at Velletri. By A. E. Nordenskiöld (copied from "Ymer," 1891). *Stockholm*, 1891. 4to, pp. 29, and facsimile of map. 7s. 6d. net.

CATALOGUE OF THE COPTIC MANUSCRIPTS IN THE JOHN RYLANDS LIBRARY. By W. E. Crum. 1909. 4to, pp. xii. 273. 12 plates of facsimiles, in collotype 1 guinea net.

CATALOGUE OF THE DEMOTIC PAPYRI IN THE JOHN RYLANDS LIBRARY. With facsimiles and complete translations. By F. Ll. Griffith. 1909. 3 vols. 4to.

1. Atlas of facsimiles in collotype.
2. Lithographed hand copies of the earlier documents.
3. Key-list, translations, commentaries, and indexes.

3 guineas net.

CATALOGUE OF THE GREEK PAPYRI IN THE JOHN RYLANDS LIBRARY. By Arthur S. Hunt. Vol. i: Literary texts (Nos. 1-61). 1911. 4to, pp. xii. 204. 10 plates of facsimiles in collotype. 1 guinea net.

CATALOGUE OF THE GREEK PAPYRI IN THE JOHN RYLANDS LIBRARY. By Arthur S. Hunt. Vols. ii and iii: Non-literary documents. [*In Preparation.*

CATALOGUE OF AN EXHIBITION ILLUSTRATING THE HISTORY OF THE TRANSMISSION OF THE BIBLE. Arranged for the Tercentenary of the Authorised Version. With plates in facsimile. Demy 8vo. 6d. net.

CATALOGUE OF AN EXHIBITION OF MEDIÆVAL MANUSCRIPTS AND BOOK COVERS. Arranged for the occasion of the Manchester Meeting of the Historical Association. Demy 8vo. 6d. net.

THE JOHN RYLANDS LIBRARY. A Brief Historical Description of the Library and its contents, with Illustrated Catalogue of a Selection of Manuscripts and Printed Books exhibited in the main Library, with Plates. Demy 8vo. 6d. net.

The John Rylands Facsimiles.

A series of reproductions of unique and rare books in the possession of the John Rylands Library.

The volumes consist of minutely accurate facsimile productions of the works selected, preceded by short bibliographical introductions.

The issue of each work is limited to five hundred copies, of which three hundred are offered for sale, at a price calculated to cover the cost of reproduction.

1. PROPOSITIO JOHANNIS RUSSELL, printed by William Caxton, circa A.D. 1476. Reproduced from the copy preserved in the John Rylands Library. . . . With an introduction by Henry Guppy. 1909. 8vo, pp. 36, 8. 3s. 6d. net.

2. A BOOKE IN ENGLYSH METRE, of the Great Marchaunt man called "Dives Pragmaticus". . . . 1563. Reproduced in facsimile from the copy in the John Rylands Library. With an introduction by Percy E. Newbery; and remarks on the vocabulary and dialect, with a glossary by Henry C. Wyld. 1910. 4to, pp. xxxviii. 16. 5s. net.

3. A LITIL BOKE the whiche traytied and reherced many gode thinges necessaries for the . . . Pestilence . . . made by the . . . Bisshop of Arusiens. . . [London], [1485?] Reproduced in facsimile from the copy in the John Rylands Library. With an introduction by Guthrie Vine. 1910. 4to, pp. xxxvi. 18. 5s. net.

THE ELLESMERE CHAUCER: Reproduced in Facsimile. Price £50 net.

LE PELERIN DE VIE HUMAINE. (Privately printed for the Roxburghe Club).

TRANSACTIONS OF THE INTERNATIONAL UNION FOR CO-OPERATION IN SOLAR RESEARCH.

Vol. I, First and Second Conferences. Demy 8vo, 260 pp. and plate. 7s. 6d. net.

Vol. II, Third Conference. Demy 8vo, 244 pp. 7s. 6d. net.

Vol. III, Fourth Conference. Demy 8vo, 232 pp. 7s. 6d. net.

EXCAVATION OF THE ROMAN FORTS AT CASTLESHAW (near Delph, West Riding), by SAMUEL ANDREW, Esq., and Major WILLIAM LEES, J.P. First Interim Report, prepared by F. A. BRUTON, M.A. Demy 8vo, pp. 38, 20 plates and plans. 1s. net.

EXCAVATION OF THE ROMAN FORTS AT CASTLESHAW (near Delph, West Riding), by SAMUEL ANDREW, Esq., and Major WILLIAM LEES, J.P. Second Interim Report, prepared by F. A. BRUTON, M.A. Demy 8vo, pp. 93, 45 plates and plans. 3s. 6d. net.

THE ROMAN FORT AT MANCHESTER. Edited by F. A. BRUTON, M.A. Demy 8vo. 6s. net.

THE ROMAN FORT AT RIBCHESTER. Edited by J. H. HOPKINSON, M.A. Demy 8vo. 6d. net.

THE MOSTELLARIA OF PLAUTUS. Acting edition with a translation into English verse. Edited by G. NORWOOD, M.A. 1s. net.

THE BOOK OF RUTH (Unpointed Text). 6d. net.

THE BOOK OF AMOS (Unpointed Text). 6d. net.

THE BOOK OF JUDGES (Unpointed Text). 1s. net.

THE SECOND BOOK OF KINGS. Cap. 15—Cap. 17. (Unpointed Text.) 4d. net.

SCENES FROM THE RUDENS OF PLAUTUS, with a Translation into English verse. Edited by R. S. CONWAY, Litt.D., Professor of Latin. 6d. net.

THE POEMS OF LEOPARDI. By FRANCIS BROOKS, M.A. 3s. 6d. net.

A TARDINESS IN NATURE AND OTHER PAPERS. By MARY CHRISTIE. Edited, with Introductory Note and Memoir, by MAUD WITHERS. Crown 8vo, 331 pp. 3s. net.

MUSICAL CRITICISMS. By ARTHUR JOHNSTONE. With a Memoir of the Author by HENRY REECE and OLIVER ELTON. Crown 8vo, 225 pp. 5s. net.

MANCHESTER BOYS. By C. E. B. RUSSELL. With an Introduction by E. T. CAMPAGNAC. Crown 8vo, pp. xvi. 176, 19 plates. 2s. 6d. net.

MANCHESTER BANKS: ANALYSIS OF THE PUBLISHED BALANCE SHEETS FOR 1908, 1909, 1910, 1911, and 1912. By D. DRUMMOND FRASER, M.Com. 1s. net each.

MATERIALS FOR THE STUDY OF HEBREW COMPOSITION. Selected and arranged by M. A. CANNEY, M.A., Professor of Semitic Languages and Literatures. One vol. pp. viii. 52, interleaved. Paper covers, 1s. net.

JOURNAL OF THE MANCHESTER ORIENTAL SOCIETY, No. 1, 1911. Pp. xvi. 162, with 8 illustrations. Paper cover, 5s. net.

THE POETRY OF CATULLUS. A Lecture by Professor D. A. SLATER. 6d. net.

THE REPAYMENT OF LOANS OF LOCAL AUTHORITIES and of Commercial and Financial Undertakings. By E. HARTLEY TURNER, A.C.A. Demy 8vo, 536 pp. Cloth, 21s. net.

BIBLIOGRAPHIA BOLTONIENSIS: being a Bibliography, with bibliographical details of Bolton Authors, and the books written by them from 1550 to 1912; books about Bolton, and those printed and published in the Town from 1785 to date. By ARCHIBALD SPARKE, F.R.S.L., F.L.A. (Chief Librarian of Bolton). Medium 4to wrappers, 212 pp. 5s. net.

MUSEUM HANDBOOKS

W. E. HOYLE. Handy Guide to the Museum [15] ... ... 1d.
W. E. HOYLE. General Guide to the Natural History Collections (Illustrated) [26] ... ... 6d.
S. J. HICKSON. Outline Classification of the Animal Kingdom [14] New (4th) Edition, interleaved 6d. each, 5/- doz.
F. E. WEISS. Outline Classification of the Vegetable Kingdom [5] (*out of print*) ... ... 2d.
S. J. HICKSON. Catalogue of the Embryological Models [40] ... ... 2s.
H. BOLTON. Catalogue of the Type Fossils [6] (*out of print*) ... ... 2s.
— Supplementary List of Type Fossils ... ... 6d.
W. E. HOYLE. Catalogue of the Museum Library [12] ... 2s. 6d.
J. C. MELVILL and R. STANDEN. Catalogue of the Hadfield Collection of Shells (Part I.) 2 Plates [11] (*Out of print*) ... ... 1s.
J. C. MELVILL and R. STANDEN. Catalogue of the Hadfield Collection of Shells (Parts II & III.) 3 Plates [16] ... ... 2s.
J. C. MELVILL and R. STANDEN. The Marine Mollusca of Madras, Marine Shells from Lively Island, Falklands, etc. [24] ... ... 1s.
C. D. SHERBORN. Index to the "Systema Naturæ" of Linnæus [25] ... ... 3s. 6d.
H. BOLTON. Nomenclature of the Seams of the Lancashire Lower Coal Measures [22] ... ... 1s.
B. HOBSON. Correlation Tables of British Strata [34] ... 5s.
H. BOLTON. The Palæontology of the Lancashire Coal Measures (Part I.) [50] 1s. (Parts II. and III.) [56] (*Out of print*) ... ...
J. C. MELVILL. A Brief Account of the Cosmo Melvill Herbarium [54] ... ... 6d.
F. E. WEISS. Chapters from the Evolution of Plants [64] 6d.
W. H. PEARSON. Catalogue of Hepaticæ (Anacrogynæ) in the Manchester Museum [67] ... ... 6d.
MARGARET A. MURRAY. The Tomb of Two Brothers, an account of two mummies unrolled at the Museum in 1908 [68] ... ... 5s.
A. S. GRIFFITH. Catalogue of Egyptian Antiquities [70] 1s. 6d.

MUSEUM LABELS

The following sets of Labels have been published by the Museum, and may be had at the prices affixed on application to the Keeper, post free if cash is sent with order:—

Descriptive Labels of the Sub-classes and Orders of Mammals, on sheets about 10 inches by 8 inches 15s.
The Families of Mammals, according to Flower and Lydekker, in ½-inch block letters, red ink ... ... 10s. 6d.
The Families of Birds according to the British Museum Catalogue, in similar style ... ... 10s. 6d.
The Principal Families of Fishes, according to Boulenger, Camb. Nat. Hist., in similar style ... 10s. 6d.

Map of the World, illustrating distribution in space and time (per hundred) ... ... 5s.
The Priucipal Divisions of Coleoptera, in labels 4 inches long, red or black [29] ... ... 3d.
The Principal Divisions of Lepidoptera, in similar style [35] ... ... 3d.
The Families of Worms, in similar style [32] ... ... 6d.
The Principal Divisions of the Cœlenterata [61] ... ... 1s.
The Principal Divisions of Amphibians and Reptiles

Notes from the Manchester Museum

1—T. H. Huxley. Suggestions for a Natural History Museum in Manchester [17] ... ... 6d.
2—Thomas Hick. On Rachiopteris cylindrica Will. [18] 6d.
3—S. J. Hickson. On the Ampullæ of Millepora [19] ... 6d.
4—H. Bolton. Descriptions of Brachiopoda and Mollusca from the Millstone Grit, etc. [20] ... ... 1s.
5—H. Bolton. Palæontology of the Manx Slates [27] ... 1s.
6—A. C. Seward. Notes on some Jurassic Plants in the Manchester Museum [30] (*out of print*) ... ... 1s.
7—W. Boyd Dawkins. On the Cairn and Sepulchral Cave at Gop, near Prestatyn [36] (*out of print*) ... 6d.
8—F. E. Weiss On Xenophyton radiculosum (Hick) [37] 1s.
9—W. E. Hoyle. British Cephalopoda [39] (*out of print*) 6d.
10—W. Boyd Dawkins. The Red Sandstone Rocks of Peel (Isle of Man) [41] ... ... 1s.
11—W. Boyd Dawkins. Carboniferous, Permian and Triassic Rocks of the Isle of Man [42] ... ... 6d.
12—W. Boyd Dawkins. On Bigbury Camp and the Pilgrim's Way [43] ... ... 1s.
13—W. E. Hoyle. The Use of Museums in Teaching [44] (*out of print*) ... ... 6d.
14—W. E. Hoyle. The Type Specimen of Loligo eblanæ [45] ... ... 6d.
15—J. R. Hardy. The Macro-Lepidoptera of Sherwood Forest [46] (*out of print*) ... ... 3d.
16—W. Boyd Dawkins. Discovery of an Ossiferous Pliocene Cavern at Doveholes [47] ... ... 1s.
17—W. Boyd Dawkins. On the Discovery of Elephas antiquus at Blackpool [51] ... ... 6d.
18—W. E. Hoyle. A Diagnostic Key to the Genera of Recent Dibranchiate Cephalopoda [52] ... ... 1s. 6d.
19—Theophilus D. Pinches. The Hymns to Tammuz [55] 3s. 6d.
20—W. E. A. Axon. Votive Rag-Branches and Prayer-Stick [58] ... ... 1s.
21—W. E. Hoyle. The Education of a Curator [60] ... 6d.
22—R. Standen. Glue and Turpentine Cement for Alcoholic Mounts [65] ... ... 6d.

Reports on the Progress of the Museum

1889-1912 (*Published Yearly*) ... ... (each) 6d.

Date Due
